

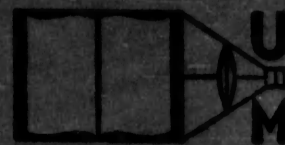
Vol. XX

No. 1

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MONOGRAPHS IN MICROFORM*

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UNIVERSITY MICROFILMS, INC.
ANN ARBOR, MICHIGAN: 1959

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AGRICULTURE

AGRICULTURE, GENERAL

METHODOLOGICAL PROBLEMS AND POSSIBILITIES IN FARM BUSINESS ANALYSIS USING INTER-FARM PRODUCTION FUNCTIONS

(L. C. Card No. Mic 59-2691)

Robert Daniel Bell, Ph.D.
Cornell University, 1959

This study represents an attempt to investigate some of the operational characteristics of the production function approach for analyzing the financial experiences of farmers in resource allocation and productivity. As an exploration mainly in farm management methodology, its purpose is not to give final answers to practical problems facing individual farmers. The concern in this study is to present a synthesis of production function theory and to explore in detail the kind and seriousness of problems in carrying out production function analysis in an empirical study. In carrying out the above objectives, the study focuses attention on the overall problem of the extent to which the production function approach is adapted to farm management research. The concepts and analytical procedures employed represent an attempt to provide answers to these questions.

Following some of the basic aspects of the production function approach, the difficulties encountered in an empirical study are presented. Problems arise from difficulties encountered in measuring accurately certain relevant input variables, from the arbitrariness in theoretical specifications in choosing the algebraic form for the production function, from the estimation procedure to be employed in fitting the production model to empirical data, from the aggregation of inputs and outputs necessary to make the production relation manageable, and from the lack of any observations on pertinent input variables that influence the production process significantly. The aggregational process is discussed from its conceptual, economic and statistical viewpoints. The problem of selecting farms from which to obtain input-output data for deriving production functions is treated in terms of a sampling scheme which represents a distinct departure from random and record samples currently in use. The choice of an estimation procedure for fitting the production function is treated in terms of the single-equation and simultaneous-equation model of production. Attention is also focused on the influence of a number of considerations in empirical analysis, such as errors in measuring important input variables, disregarding known farm-to-farm qualitative differences in relevant input variables, and our present inability to quantify the entrepreneurial or managerial services.

Finally, empirical production functions, using data available to the present study, are presented and examined in order to aid in making generalizations for the study and the method of farm business analysis generally. Attention

is focused on the possible usefulness of parameter estimates and hence about the relative merits of alternative ways for specifying and combining inputs in the power-type function used, and on suggestions for improving the analysis in future work along these lines. A number of complexities arise in connection with the empirical analysis attempted in this study. The seriousness of these complexities is of such magnitude as to preclude the use of parameter estimates in making recommendations for more efficient resource use on individual farms. None of the empirical equations can be said to give completely satisfactory results for partitioning production into effects attributable to individual input categories because many of the parameter estimates have rather large standard errors and some (i.e., land and labor) indicate illogical directions of variation. Considerations stemming from the underlying analysis revolve around handling the intercorrelation among the inputs, non-homogeneity of inputs classified into categories and the need for some new and improved ways for obtaining data for measuring production relations if the production function approach is to be widely recommended for analyzing the experiences of farmers. A real question revealed by the study, however, is whether we could expect in a homogeneous area with farmers in fair adjustment with technology and resources to get the kind of data needed for obtaining acceptable estimates of the necessary parameters. While some improvement may be possible, experience in this study makes it seem highly doubtful that a wide cross section of different levels of inputs used could ever be found in a homogeneous area.

Microfilm \$2.00; Xerox \$7.00. 149 pages.

STUDIES ON ORGANIC UNIDENTIFIED GROWTH FACTORS REQUIRED BY THE CHICK

(L. C. Card No. Mic 59-2464)

Richard Dam, Ph.D.
Cornell University, 1959

Introduction

Experiments have been conducted a) to determine whether or not known chemical substances reported to have chick growth factor activity were responsible for the activity found in sources of unidentified growth factors; b) to attempt to control or eliminate interference of environmental bacteria with growth factor activity during the experimental period; c) to fractionate further a crude liver fraction in an attempt to isolate and identify its active growth promoting components; and d) to develop a diet adequate in known nutrients which when supplemented with sources of unidentified factors promoted growth equal to that obtained with commercial rations.

Results and Conclusions

Mevalonic acid, thioctic acid, orotic acid and adenosine, either singly or in combination, were found not to stimulate chick growth.

Zephiran chloride when added to the drinking water effected its sterilization. Although limitation of water intake may have been responsible for the poorer growth of the chicks receiving Zephiran, the possibility also exists that Zephiran eliminated from the drinking water bacteria which synthesize a substance required for chick growth. The use of streptomycin, sulfasuxidine and mycostatin had little or no effect in reducing total numbers of intestinal bacteria, but yeasts were apparently eliminated. A growth response was obtained with sources of unidentified factors with Zephiran in the drinking water or with antibacterials in the diet.

Marked growth stimulation was obtained by the iso-nitrogenous addition of 1.5% or 2% of the liver fraction to a purified soybean protein basal diet containing 0.27% potassium, 0.26% sodium and 5 ppm zinc. The ash of the liver fraction when added to this diet did not stimulate growth. When the mineral content of the diet was increased to 0.5% potassium, 0.33% sodium and 50 ppm zinc, the addition of the liver fraction did not improve growth, and little or no response was obtained from other sources of unidentified growth factors. The possibility is suggested that the zinc and potassium responses are interrelated with the organic factor response in such a way that when zinc and potassium are present in lower levels in the diet the response to the organic factor is enhanced.

Diets were formulated using increased protein content and 5, 10, and 20% corn oil in place of the 3% hydrogenated fat usually used. With these diets, a more marked stimulation from organic factor supplementation was obtained earlier in the experimental period. Several different highly unsaturated vegetable oils, and a sample of triolein, promoted growth to approximately the same extent when fed at a level of 10% of the diet. Basal growth obtained using either 10% hydrogenated fat, 10% coconut oil or 10% triacetin in the diet was lower than that obtained with the unsaturated oils.

During the course of the experiments it was noted that regardless of mineral level the use of 10% corn oil caused improvement in growth over that obtained with 5% corn oil. No additional improvement was observed by increasing the dietary fat to 20%. This effect of fat was not found to be due to any constituent in its non-glyceride fraction. Furthermore, it appeared not to be due to its content of essential fatty acids, since the diets containing 5% corn oil were more than adequate in them. This unidentified effect of fat is believed to be caused by either an unidentified factor in its fatty acid fraction, or a stimulatory effect of higher fat levels on food intake, with a concomitant more efficient utilization of dietary ingredients for growth.

Microfilm \$2.00; Xerox \$6.00. 123 pages.

THE FUNCTIONAL BASIS FOR LAND UTILIZATION

(L. C. Card No. Mic 59-1896)

Charles R. Davenport, Ph.D.
University of Maryland, 1958

Supervisor: Dr. George M. Beal

Problems faced in the utilization of agricultural resources point up the need for a basic objective in agricultural policy. The fundamental issue involved is the mutual adjustment of production and consumption. Such an adjustment hinges on food requirements. For this purpose, a flexible approach to food requirements is essential. This study is an attempt both to formulate nutritional requirements on a flexible basis which can be used to establish land utilization objectives and to indicate methods and areas of application.

The objectives of this study were: (1) To determine and analyze the factors involved in nutrition; (2) to ascertain which nutritional factors are strategic to land utilization; (3) to establish the quantitative and qualitative requirements of these nutritional elements; (4) to develop a model based upon this analysis which can be used for the actual determination of the basic nutritional needs of an area; (5) to relate principles of nutrition and land utilization; (6) to apply the model developed in an analysis of selected countries to determine basic policy implications; (7) to offer some suggestions on the application of nutritional requirements as the functional basis for land utilization; and (8) to analyze food consumption and production adjustment programs of the United States.

It was found that of the many factors of nutrition, three elements provide a basis for land utilization. These elements are calories, protein and fat.

The quantitative and qualitative requirements of these basic elements were determined. Caloric needs depend upon age, sex, body surface area, activity, specific dynamic action, and climate. Protein needs are based on age and body weight. Fat is not essential in the same sense as are calories and protein, but is necessary in high energy diets and important in diet habits.

Model forms for the estimation of nutritional needs of any area were developed. Nutritional requirements and production of the United States were evaluated by this approach. The results indicated that food consumption in the United States in 1955 was slightly below satisfactory nutritional levels.

Methods of consumption and production adjustment were discussed and analyzed to determine their nature and relative importance. Based upon this analysis, recommendations were made as to consumption and production adjustments needed in the United States. Projecting food requirements and production potential for the United States to 1965, shifts from direct crop production to indirect crop production were recommended. Program recommendations to carry out this shift were also made.

Microfilm \$2.35; Xerox \$8.20. 178 pages.

**SOME SOIL-PLANT RELATIONSHIPS OF
POTASSIUM AND MAGNESIUM**

(L. C. Card No. Mic 59-2354)

Dwight Hovland, Ph.D.
University of Minnesota, 1959

Adviser: A. C. Caldwell

It has been observed that sugar beet and potato foliage on potassium fertilized plots was not as dark green as that on plots which were not so treated. It was suggested that this lighter green may have been due to magnesium deficiency induced by high potassium.

One way in which the addition of potassium to soils may result in less magnesium available for plants is a decrease in the ease of replacement of soil magnesium. This was studied by chemical analysis of soil and plant samples from field and greenhouse experiments on soils of the Red River Valley. Plant samples were analyzed for potassium and magnesium. Concentrations of potassium and magnesium were determined in saturation extracts of soil samples and these concentrations were used to calculate $\frac{1}{2}$ pMg-pK values which reflect the ease of replacement of soil magnesium by potassium.

Samples of the A_p and C horizons of the soils were analyzed chemically and mineralogically. These soils were found to be alkaline in reaction, medium to high in organic matter and adsorbed phosphorus, and low to high in cation exchange capacity. They contained free alkaline earth carbonates and high amounts of various potassium fractions but did not contain excessive amounts of soluble salts. The MgCO₃ content of the soils ranged from 2 to 11%.

Montmorillonite was the predominate type of clay mineral.

Potassium content of most of the plants was relatively high. Most of the plants contained higher amounts of magnesium than is commonly reported and were presumed not to be deficient in magnesium. However, the magnesium content generally was lower in plants grown on soils treated with potassium than in plants from untreated soils.

Studies of the saturation extracts of the soils showed that as an overall characterization the $\frac{1}{2}$ pMg-pK values failed to consistently reflect any influence of the addition of potassium fertilizer. They were inconsistent in a Fargo soil in the greenhouse study and in another Fargo soil in the field. On the other hand $\frac{1}{2}$ pMg-pK values generally increased with potassium treatment in a Fargo soil in the greenhouse and a Fargo soil and Glyndon soil in the field.

A decrease in the ease of replacement of magnesium would be expected to coincide with a decrease in the plant content of magnesium. When fertilizer treatments were ignored and an experiment was considered as a whole, there was little consistent correspondence between $\frac{1}{2}$ pMg-pK values and percent magnesium in plants. When fertilizer treatments were taken into account, phosphorus for example, the magnesium content of the plants was generally lower where magnesium was more difficultly replaced from the soil. It would appear that phosphorus fertilizer, in some way, influenced the relationship between magnesium uptake by plants and the ease of replacement of soil magnesium. The soil characteristics that were determined were only of minor assistance in explaining inconsistencies in soil and plant magnesium relationships.

It was concluded that the concept of the ease of replacement of one cation by another as a means of characterizing the nutrient balance in soils was not universally applicable as was shown with the soils in this study for reasons as yet undetermined.

Microfilm \$2.00; Xerox \$4.80. 95 pages.

**INHERITANCE OF FIBER FINENESS IN
THE INTERSPECIFIC HYBRID GOSSYPIMUM
HIRSUTUM X G. BARBADENSE**

(L. C. Card No. Mic 58-2845)

Saad Abdel-Latif Kamel, Ph.D.
Louisiana State University, 1958

Supervisor: Professor M. T. Henderson

The material consisted of the parents, F₁, F₂, and F₃ populations for the interspecific hybrid DPL 15 (*Gossypium hirsutum*) x Sea Island (*G. barbadense*). The characters analyzed were fiber wall thickness and perimeter, the two major components of weight fineness. The arealometer was used in measuring these characteristics.

The three fiber properties behaved as quantitative characters, although not typical of such characters in all respects. Abnormal segregates with extra fine and thin-walled fibers were encountered in the two segregating generations.

Absence of dominance was exhibited for wall thickness and perimeter. No conclusive evidence could be drawn concerning nature of gene action, whether it was geometric or arithmetic. The parental mean difference for each character was controlled by a few pairs of genes. This indicates that recoveries of apparent parental genotypes could be obtained in a relatively small population. Transgressive segregates were found, denoting a chance for cotton breeders to obtain plants superior to either parent.

High heritability values were obtained from the F₂ data. Also, heritability as measured from correlation and regression of F₃ lines on their respective F₂ phenotypes was very high for wall thickness and weight fineness, but relatively low for perimeter. Selection on the individual plant basis from the F₂ was highly effective for the three characters, except for large perimeters.

A low but significant correlation was found for wall-thickness and perimeter, implying little difficulty would be encountered in combining the high or low expressions of the two characters in one strain.

High positive and significant correlations were obtained for weight fineness and its two components. Desirable expressions of weight fineness could be reached through selection of one of its two components, or both.

Microfilm \$2.00; Xerox \$5.20. 104 pages.

INTERREGIONAL COMPETITION IN THE TOMATO PROCESSING INDUSTRY

(L. C. Card No. Mic 59-1627)

Alfred Robert Koch, Ph.D.
Purdue University, 1959

Major Professors: Milton M. Snodgrass and
Vernon W. Ruttan

The tomato processing industry has changed considerably during the past twenty years. The production of tomatoes for processing has gradually moved westward into California. Per capita consumption trends have not been uniform for canned tomatoes and tomato products. Processing establishments have changed both in size and geographic distribution. Within this setting the following major objectives were outlined for this study:

- 1) To determine the optimal distribution patterns for canned tomatoes, catsup, and tomato juice from surplus to deficit areas, and to determine the optimal location of tomato production.
- 2) To compare the existing patterns of production and movement of products with the optimal solutions to point up the degree of difference.

The transportation model of linear programming was the analytical technique used to yield quantitative answers. The United States was divided into twenty regions. Data concerning production, consumption, and transportation costs were assembled and utilized in the transportation model. Internal plant processing costs, consumer preferences, grade differences, advertising and discriminatory pricing as factors that influence the production and consumption patterns of canned tomatoes and tomato products were built into the model by changing production estimates, consumption estimates, and the relative cost structure.

Existing distribution patterns did not entirely agree with the derived optimal patterns. Results indicate that from a standpoint of cost minimization, California canned tomato, catsup, and juice production which actually moves into all regions of the United States generally should be channeled to all states west of the Mississippi River and into the Gulf States and New England. In order to minimize costs, the market area of processors in the Midwest, (Indiana, Ohio, Illinois, and Michigan) should be contracted in the West, and expanded in the South and Northeast as compared to the existing distribution patterns. The optimal distribution patterns indicated for the Tri States (Maryland, New Jersey, and Delaware) generally agreed with existing patterns.

In addition to yielding optimal distribution patterns the transportation model solutions simultaneously yield marginal cost values. These are useful in studying the effect of any shift away from the optimum. If the optimal distribution patterns were to change, the marginal cost values indicate that a shift of catsup production from the Tri States towards the West would reduce aggregate cost while a shift of juice production from California towards the East would reduce aggregate cost. A shift of canned tomato production from east to west for the fancy, extra standard, and standard grades would also be cost reducing.

Besides the marginal cost values the solutions also yield a set of "equilibrium" prices which are necessary to bring about the optimal distribution pattern. By comparing the actual prices received by canned tomato, catsup, and

juice processors with the equilibrium prices pricing efficiency within the industry can be ascertained. Evaluation of the actual price, equilibrium price differences indicated that pricing inefficiencies exist within the tomato processing industry. Production is so heavily concentrated in California that the prices of canned tomatoes and tomato juice in the other regions appear to be dependent on the excess California production. "Responsible" catsup pricing policies characterized by price leadership appear to be a causal factor for the actual catsup price to deviate from the equilibrium price.

Costs of processing canned tomatoes, catsup, and tomato juice were calculated by region, added to the transportation costs and used to determine the optimal location of production so that total cost would be a minimum. Regional production of canned tomatoes, catsup, and tomato juice was not a predetermined variable in the model. The transportation cost, processing cost structure determined if any production occurred in a given region. The optimal location of production did not entirely agree with the existing production patterns. The production of tomatoes for processing was decreased slightly in California and increased in the Midwest and Tri States as compared to existing production patterns. In the model solution, California produced seventy-two percent of the national catsup output, forty-three percent of the canned tomato output and thirty-three percent of the tomato juice output. California actually produces approximately forty-five percent of the United States canned tomato, catsup, and tomato juice output. In the model solution, the Midwest produced thirty-two percent of the national canned tomato output, twenty-three percent of the juice output, and twenty-eight percent of the catsup output. Actually, the Midwest produces approximately fifteen percent of the national canned tomato output and twenty percent of the catsup and juice output. In the model solution, the Tri States produced twenty-five percent of the national canned tomato output and forty-four percent of the tomato juice output. Compared to existing production, Tri State canned tomato output remained near present levels while juice production was increased and catsup was not produced.

This study provides another example of the application of linear programming techniques to interregional competition within the tomato processing industry.

Microfilm \$2.75; Xerox \$9.40. 210 pages.

THE APPARENT MOBILITIES OF POTASSIUM AND CHLORINE IN SOIL

(L. C. Card No. Mic 59-2034)

John Letey, Jr., Ph.D.
University of Illinois, 1959

The apparent mobilities of potassium and chlorine were measured in saturated bentonite, kaolinite, and sub-soil systems as a function of salt concentration. Two experimental procedures were used to determine the apparent mobilities. One method combined transference number results with specific conductance values of plugs made up of the various soil materials. The transference numbers were measured by a modified Hittorf method for

transference number determinations. A direct current procedure was used to measure specific conductances. The other procedure of measuring apparent mobilities involved measuring a self-diffusion coefficient which is related to the ionic mobility by the Nernst-Einstein equation.

The apparent mobilities of potassium increased as the salt concentration increased, and the apparent mobilities of chlorine decreased with increasing salt concentration. The apparent mobilities for chlorine which were calculated from self-diffusion results were lower than those calculated from transference-conductivity experiments however gave a similar relationship with respect to concentration. No self-diffusion coefficients were determined for potassium.

The apparent mobilities were higher for chlorine than for potassium in all cases.

The results can be explained on the basis of the ionic distribution with respect to the charged clay surface. Low apparent cation mobilities are a result of a large proportion of the ions being in the vicinity of the charged surface where they are attracted to the fixed negative charge. The mobility of ions near the charged surface is also reduced perhaps because of the higher viscosity of water near the clay surface. Anions as opposed to the cations have a lower proportionate amount near the clay surface at low concentrations as compared to higher concentrations.

Neglecting geometric factors such as the area and effective path length an ion has to travel, the influence of such factors as porosity, salt concentration, and fixed charge density on ionic mobilities is probably brought about by the effect that these factors have on the ionic distribution about the charged surface. The results indicate that ions have low mobility when they are located near the charged surface and increase in mobility as they become removed from the surface. Therefore factors which cause ions to be distributed near the charged surface will cause a reduced apparent mobility.

The salt diffusion coefficient calculated from the apparent mobilities which are experimentally determined become larger with increasing salt concentration. Clearly Fick's diffusion laws cannot be used in charged soil systems without considering the diffusion coefficient as concentration dependent.

Microfilm \$2.00; Xerox \$5.60. 107 pages.

A METHOD FOR IMPROVING THE FLAVOR AND KEEPING QUALITY OF CREAMED COTTAGE CHEESE

(L. C. Card No. Mic 59-1630)

Donald Williamson Mather, Ph.D.
Purdue University, 1959

Major Professor: Dr. F. J. Babel

Creamed cottage cheese has assumed considerable economic importance in the dairy industry within the past few years. This is evident from production figures which show an increase from 352,428,000 pounds in 1950 to 653,599,000 pounds in 1956. Further increases can be attained by improvements in the flavor and keeping quality.

Biacetyl is an important flavor contributor to creamed cottage cheese, but analyses on 41 commercial samples showed that it varied from 0.0 to 3.2 ppm. Studies were conducted to determine the relationship between the flavor compounds formed in lactic cultures and those formed during the manufacture of cottage cheese. Also, the methods suggested for increasing the biacetyl content of lactic cultures were applied to the creaming mixtures used for cottage cheese.

Lactic cultures grown in skim milk under conditions similar to those employed in the manufacture of cottage cheese by the long-set method produced considerable amounts of biacetyl, acetylmethylcarbinol and volatile acids. However, when the skim milk had coagulated and was separated into curd and whey, most of these compounds were partitioned into the whey fraction. Citric acid, the source of biacetyl and volatile acids, was almost completely absent in cottage cheese.

The addition of citric acid to a creaming mixture for cottage cheese did not increase the biacetyl content during storage, whereas cheese creamed with a mixture containing lactic culture and citric acid did show an increase. However, the culture addition did not improve the flavor of the creamed cottage cheese because acid was formed by the added culture and this resulted in a sour-flavored cheese. The addition of *Streptococcus citrovorus*, one of the organisms frequently associated with *Streptococcus lactis* in lactic cultures, to a creaming mixture caused an increase in biacetyl during storage of creamed cottage cheese. The addition of 0.15% citric acid, in addition to the culture gave greater increases in biacetyl. A sour flavor was not evident since *S. citrovorus* does not produce lactic acid.

The most satisfactory method for standardizing the flavor of creamed cottage cheese was by the use of a creaming mixture prepared as follows: Skim milk was steamed for 1 hour, cooled to 21°C., inoculated with 2% *S. citrovorus* and held at 21°C. for 24 hours. Subsequently, it was acidified to pH 4.30 with citric acid and incubated for 20 to 24 hours at 21°C. The skim milk thus treated was used to standardize the fat content of 20% cream to 12%, or if less biacetyl was desired, milk (3.8% fat) could be included in the standardization. Single stage homogenization of this special creaming mixture at 70° to 80°F. and 500 pounds pressure per square inch decreased the amount of whey separation in the creamed cottage cheese during storage. Cottage cheese creamed with such a creaming mixture had a satisfactory flavor immediately after creaming and the biacetyl content increased slightly during storage at 45°F. for 11 days. The biacetyl content of curd creamed with this creaming mixture and held at 50°F. increased for 5 days and then decreased appreciably.

The special creaming mixture had a definite effect on the growth of certain organisms known to cause spoilage of creamed cottage cheese. For example, the addition of *Pseudomonas fragi* in amounts equivalent to 67,000 and 670,000 organisms per g. creamed curd, caused definite slime formation in a regularly creamed curd stored at 45°F. for 7 days, but samples containing the same amounts of *Ps. fragi* and creamed with the mixture containing *S. citrovorus* were not spoiled after storage for 12 days. Similar results were obtained when *Pseudomonas putrefaciens* was used as the test organism.

Yeast (*Candida pseudotropicalis*) and mold (*Geotrichum candidum*) growth in creamed cottage cheese was not

inhibited by the use of the creaming mixture containing *S. citrovorus*. An uncultured creaming mixture acidified with citric acid to the pH of the creaming mixture containing *S. citrovorus* did not retard microbial spoilage in creamed cottage cheese inoculated with *Ps. fragi*, *C. pseudotropicalis* or *Escherichia coli*.

The growth of *E. coli* was inhibited in cottage cheese creamed with the mixture containing *S. citrovorus* when the amount of contamination was not in excess of about 1,800 organisms per g.

Microfilm \$2.00; Xerox \$5.60. 115 pages.

AN AGRICULTURAL REGIONS CONCEPT FOR NEW YORK STATE

(L. C. Card No. Mic 59-2472)

Kenneth Charles Nobe, Ph.D.
Cornell University, 1959

This is a progress report on a study of agricultural regions of New York State. It is the first in a series of reports on a state-wide project which is still underway and likely to continue for a number of years to come. This report focuses on the development of the agricultural regions concept, sources of information, methodology and a discussion of the performance characteristics of farm real estate within the Central Plain Region.

The agricultural regions project represents an attempt to identify areas of the state which are meaningfully different from one another from a farmer's point of view. The regions are visualized as differing from one another on the basis of differences in real estate as measured by their performance in agricultural use. They were made of such size and homogeneity that they can be used in tailoring agricultural recommendations more nearly to the individual farm resource situation and the accompanying technical conditions of production. The current trend in agricultural extension work which focuses on area-wide problems, coupled with the fact that farmers are limited by a combination of soil, climate, topography and the man-made aspects of the farm real estate led to the mobilization of this study.

Information of many kinds has been assembled in this report: Information from studies of soil, geology, climate and topography; information from studies of land use and farm management, sociology surveys, censuses, and marketing studies; and the results of research in the physical production fields and agricultural engineering. Airphotos were used extensively in areas for which recent coverage was available and in situations to which they could be adapted. The Central Plain was used essentially as a "case study" to demonstrate how data from many factors which occur together in a given area can be combined and interwoven to produce a performance evaluation under agricultural use.

Agricultural development of New York State in the future will continue to be regulated to a large extent by the performance capacity of its agricultural resources. More than nine million acres of farm land in the state has been technologically displaced. Many factors play a part in determining the performance capacity of individual farm units that remain and these factors have been studied

independently within the College of Agriculture at Cornell for over half a century. Since these factors all influence farming in an interrelated manner, it was considered worthwhile to combine the results of economic researches with the results of soil, climatic, and topographic studies on one map -- a map that pictures meaningfully different combinations in farm real estate.

Such a map will be useful as a framework upon which to build future research and extension programs in agricultural economics and to some extent may also be useful in allied fields such as soil science and agronomy. A preliminary map of agricultural regions along with abbreviated descriptions of the regions has been published in conjunction with this thesis study. The lines on this map are expected to change gradually in the future and as new research data becomes available more comprehensive descriptions of the regions can be compiled. This map is perhaps more preliminary than future modifications of it will be because it is the first attempt, but in a real sense such maps will always be preliminary; such maps will show only one point in time of a continuously evolving agriculture. Such maps are useful, however, until subsequent approximations take their place.

Major emphasis in this report has been placed on tracing through the thinking that has evolved as this study progressed. The material presented is largely based on first-hand observations and evaluations by the author. These were conditioned by suggestions and criticisms of specialists in many subject matter fields. The focus of this report is not of the nature which can be statistically validated by tables and graphs of the type usually found in standard agricultural economic studies at Cornell. It will have served its purpose, however, if it helps to facilitate the gathering and dissemination of information important to farmers. Microfilm \$6.95; Xerox \$24.00. 548 pages.

AGE CORRECTING DAIRY RECORDS ACCORDING TO THE LEVEL OF HERD PRODUCTION

(L. C. Card No. Mic 59-2474)

Shayle Robert Searle, Ph.D.
Cornell University, 1959

Lactation yields of dairy cows generally increase until the cow is about 9 years of age, and then decrease. Differences between young and old cows have to be taken into account when progeny-testing a bull by comparing the productions of his daughters with those of other, and generally older, cows. This is done by applying age correction factors to the records of the young cows. Factors presently in use were not specifically designed to allow for age effects being different among herds, so the possibility of doing this has been investigated.

In this study cows aged 5-9 1/2 years have been called mature, and younger cows have been divided into four groups. For each group the linear regression was estimated of the age difference for a herd, mature cow average - young cow average, on the age-corrected herd average, this being defined as

$$\text{age-corrected herd average} = \text{actual herd average} + \text{corrections for age.}$$

This definition leads to an explicit function for the age-corrected herd average in terms of the actual herd average and the regression parameters. This is done by substituting the expected values of the age differences into the corrections for age.

The regressions were estimated from some 20,000 Holstein records in 750 herds in New York State, first using the actual herd average as an approximation to the age-corrected herd average. These first regression estimates were then used in the expression for the age-corrected herd average, to obtain a first approximation to it. This was done for each herd in the study, and these values used to give a second estimate of the regressions, and the procedure continued until the estimated slopes at the fifth round of the process were found to be the same as those at the fourth. These final estimates of the regressions are shown below.

**ESTIMATED AGE CORRECTIONS FOR
A HERD HAVING AN AGE-CORRECTED
HERD AVERAGE h . (LBS. BUTTERFAT)**

Age Group	Age Correction
1: 19-27 months	$8 + .24h$
2: 28-34 months	$-19 + .25h$
3: 35-44 months	$-18 + .19h$
4: 45-59 months	$-8 + .07h$

The equation for the age-corrected herd average h , is

$$h = \frac{\text{actual herd total} + (8n_1 - 19n_2 - 18n_3 - 8n_4)}{\text{no. of cows in herd} - (.24n_1 + .25n_2 + .19n_3 + .07n_4)}$$

where n_1 , n_2 , n_3 and n_4 are the numbers of cows in the herd in the four young-cow age groups respectively.

The regression slopes are significantly different from zero, and at herd levels between 300 and 600 pounds of butterfat, the differences between the lines are significantly different.

Several components of variance analyses on records corrected by these factors, and by the multiplicative ones used in New York, failed to reveal any significant differences between these two sets of factors. Hence comparisons of herd averages age-corrected by the multiplicative factors appear to be free of age differences, but this might not be true for comparisons of daughter averages of different sires.

No good basis for comparing different sets of age correction factors has been established: several criteria have been considered, and found wanting, namely the effect on repeatability, reduction in the variance due to age, maintenance of a constant coefficient of variation, and reduction in the age-by-herd interaction variance. The problem of finding a satisfactory criterion for judging the effectiveness of age correction factors remains unsolved.

Microfilm \$2.00; Xerox \$4.80. 95 pages.

**STORAGE BEHAVIOR OF THE SWEET POTATO
(*IPOMEA BATATAS* LAM.) AS INFLUENCED BY
MODIFIED ATMOSPHERES**

(L. C. Card No. Mic 59-2538)

Taze Leonard Senn, Ph.D.
University of Maryland, 1958

Supervisor: Dr. Leland E. Scott

Effects of oxygen and carbon dioxide concentrations of storage atmospheres on the composition and quality of roots and subsequent respiratory activity of tissue discs of Nemagold sweet potatoes were measured during the 1956 and 1957 storage seasons.

In one experiment conducted immediately after the curing period there occurred a marked disappearance of dry matter during storage of the roots in the four per cent oxygen and the 100 per cent nitrogen atmospheres. In all other tests, the effects caused by modification of the atmospheres on changes in composition during storage were negligible. Roots stored in anaerobic or partially anaerobic atmospheres, upon removal to normal air, developed necrotic spots on the surface and browning of the tissue just beneath. Roots stored in atmospheres of two or four per cent oxygen, 20 per cent carbon dioxide, or 100 per cent nitrogen developed alcoholic flavors which disappeared after exposure of roots to normal air.

Increasing oxygen concentrations above 20 per cent had little effect on the respiratory activity of the tissue discs. At levels of seven and four per cent oxygen, respiratory activity was approximately three-fourths that of normal. Carbon dioxide production and oxygen uptake were affected similarly. In four per cent oxygen atmospheres, oxygen uptake by discs increased rapidly with temperature increases from 15 to 25 degrees C, but remained fairly constant thereafter to 40 degrees C, whereas carbon dioxide production increased with temperature through 40 degrees C.

Tissue discs shifted from anaerobic to aerobic atmospheres showed an immediate respiratory activity characteristic of discs held in aerobic atmospheres. Respiratory activity of discs from roots stored in anaerobic or partially anaerobic atmospheres was greatly reduced. However, after exposure of roots to air, respiratory activity increased to an above normal rate.

The storage behavior of the roots of the sweet potato as measured by compositional changes or organoleptic qualities was not beneficially affected by changes in the normal oxygen and/or carbon dioxide content of the storage atmosphere. Microfilm \$2.00; Xerox \$4.00. 72 pages.

**MARKETING MEAT-TYPE HOGS AND PORK
AS A DIFFERENTIATED PRODUCT**

(L. C. Card No. Mic 59-1645)

James H. Stevenson, Ph.D.
Purdue University, 1959

Major Professor: Clifton B. Cox

The objectives of this study were to determine the cost and consumer response of marketing meat-type hogs and

pork as a differentiated product. This included determining the accuracy of live selection for meat-type quality. Data were collected on the dressing percentage, cut-out value, and cost of processing meat-type hogs. Finally, an effort was made to determine whether consumers would buy more meat-type pork when sold at the same price as regular pork, and whether they would pay a higher price for meat-type pork.

If it were found that consumers actually did prefer pork from meat-type hogs as many studies suggest, a study of the production and marketing system was deemed necessary to determine the cause for the lack of production of meat-type hogs. It was hypothesized that the pricing system was at fault.

With the cooperation of three Indiana firms, a marketing channel for meat-type hogs and pork was synthesized. The Producers Marketing Association, a large livestock cooperative marketing firm, agreed to supply hogs of meat-type quality. These hogs were then processed at the Emge Meat Packing Company of Anderson, Indiana. The meat-type pork products were sold in the five Muncie, Indiana stores of the Marsh Foodliner Company of Yorktown, Indiana. A comparison of pork sales and sales of other meats was made when meat-type pork products sold at both the same and higher prices as regular pork products.

Of the 4,253 hogs, 2,942 or 69.2 percent were rail-graded as meat-type or U.S. Number-One. The accuracy of live-grading improved substantially during the sixteen weeks of testing. At the beginning of the test, approximately sixty percent of all live-graded meat-type hogs were rail-graded as meat-type, whereas, at the end of the test the accuracy had increased to eighty percent. This increase in grading accuracy meant a reduction in per unit cost of meat-type hogs.

The average weight of all carcasses which were rail-graded and accepted as meat-type was 147.2 pounds, while the average weight of all non-meat-type carcasses was 151.2 pounds. The average live-weight for all meat-type hogs was 206.8 pounds while the average live-weight for all non-meat-type hogs was 212.6 pounds.

The average dressing percentage of all the live-graded meat-type hogs was 70.99 percent. The primal yield of the five lean cuts (loin, Boston butt, picnic, ham, belly) was 44.9 percent of live-weight.

The average backfat depth of samples of rail-graded meat-type carcasses was 1.48 inches, while non-meat-type carcasses averaged 1.74 inches of backfat. The average length of the rail-graded meat-type carcasses was 30.4 inches, while non-meat-type carcasses averaged 30.3 inches in length.

When the price of meat-type pork was the same as regular pork, consumers patronizing stores which handled meat-type pork purchased relatively 6.3 percent more pork cuts than consumers patronizing stores which handled regular pork. The greatest relative increase was for cured hams and bacon, while no more meat-type loins were purchased at the same price as regular loins.

When certain meat-type pork cuts were priced higher than regular pork cuts within the same stores, forty cents out of every pork dollar was spent for meat-type pork, while sixty cents of every pork dollar was spent for regular pork. Only meat-type Boston butts outsold regular Boston butts when the meat-type product was priced somewhat higher.

The meat packing company paid fifty cents per hundred-

weight premium for meat-type hogs, while the retailer paid a three cents per pound premium for wholesale meat-type cuts. The cost to the packer when he sorted for meat-type quality from all hogs he purchased was 24 cents per hog.

In the case where the packer paid fifty cents per hundredweight premium for meat-type hogs, it appeared that with the prices at the time of this test he would either have had to get 1.3 percent more primal cuts or a 1.1 cents per pound premium for the five lean cuts to have the same margin as regular hogs.

With the set of retail price premiums used in this test, and considering that the packer sorted for meat-type hogs from all the hogs purchased, the margin after labor costs and costs due to the live-grading inaccuracies was \$3.55 or approximately \$1.61 per hundredweight for meat-type hogs. However, this did not include the cost due to the decrease in quality of the packer's normal run of hogs.

Microfilm \$2.00; Xerox \$4.60. 86 pages.

THEORETICAL MODELS OF INTERREGIONAL COMPETITION IN THE POULTRY MEAT INDUSTRY

(L. C. Card No. Mic 59-1652)

Akira Uchida, Ph.D.
Purdue University, 1959

Major Professor: Milton M. Snodgrass

The main objectives of the study are (1) to formulate theoretical models to analyze the economic structure of the poultry meat industry in the United States, (2) to quantify the characteristics of the industry with use of the models, and (3) to determine the degree of industry development and competition among regions.

Essentially, the study was one of interregional competition in the poultry meat industry. The scope of the study was intended to include the whole United States. Due to the lack of data, the study was limited to a few states where data were available. These states were Washington, California, North Carolina, and Indiana. Particular emphasis was placed on the following aspects: definition of technology, construction of productivity functions, measurement of the degree of monopoly, and development of the cost relationships regarding the spatial aspects of interregional competition.

The analytical Technique. Linear programming, which allows the space factor to be treated explicitly, is currently being used to study problems of interregional competition. In this study, however, conventional economic theories were interpreted and refined in order to quantify the characteristics of the industry.

First, a technology is defined for each class (based on output) of operation as a vector with the components of labor, investment, and output. By this definition, technologies may be superior, inferior or indeterminate. If superior technologies are connected, the line is called an entrepreneurial path. If indeterminate technologies are connected, the resulting curve is defined as a neutral technology curve or productivity curve.

Second, technical and economic interpretations of a productivity curve are such that (1) a productivity curve

is assumed to be concave to the real-capital-ratio axis (a necessary condition for the maximization of rate of profit) and (2) when the maximum rate of profit is equal to the prevailing interest rate, the firm is in equilibrium, and (3) a productivity is a function of the interest rate.

Third, Lerner's and Kalecki's formulas were used to measure the degree of monopoly. The necessary data for Lerner's formula was not available, thus Kalecki's formula was chosen for use. In addition, Kalecki's formula is free from the questionable assumption of profit maximization.

Fourth, for the spatial aspect of the study, functional relationships of production, processing and freight costs among producers, processors, and retailers were investigated so that the mechanics of constructing iso-cost lines could be explicitly demonstrated. These functional relationships were used as the base for developing a mathematical equation which delineates the supply area of a processor. Also, the mathematical equation suggested that a mathematically intransferable and economically irrational region would result if location theory was treated from a purely mathematical standpoint.

Findings. First, there are few cases of indeterminate technologies. Therefore, it was nearly impossible to construct a productivity curve. Second, a productivity curve was in most cases convex to the real-capital-ratio axis unless a multi-convex cone technology was assumed. Analytical results would indicate that the poultry industry has a higher rate of profit than the prevailing interest rate. Third, the large southern processors have a higher degree of monopoly than the northern processors. Fourth, iso-cost lines for retailers in Chicago indicate that the southern processors are cheaper sources of dressed birds than the northern processors.

Summary. If economic variables of imperfect competition were introduced, results would be limited because of the mathematical nature of the models. However, the accuracy of the findings of this study and their subsequent use are more limited by inadequate data than by analytical procedure or the models themselves. Because average figures were used rather than the individual firm data, the degree to which the quantitative answers approximate or deviate from the actual situations cannot adequately be assessed.

Further interregional studies of this kind would yield more meaningful answers if standardized data were available from the various regions. To adequately assess interregional competition, standard data for at least a ten-year period would be necessary.

Microfilm \$2.00; Xerox \$6.20. 127 pages.

STUDIES ON THE BIOLOGY OF *RADOPHOLUS SIMILIS* (COBB, 1893) THORNE, 1949

(L. C. Card No. Mic 59-1732)

Leonardus Gijsbertus van Weerd, Ph.D.
The University of Florida, 1959

The morphological variation between individual burrowing nemas, *Radopholus similis* (Cobb, 1893) Thorne, 1949, obtained from many different hosts and localities in Florida was evaluated by comparing the morphological variation

within and between progenies of single females. The variation within the progenies proved very great. It was described and illustrated. No consistent differences were found between the progenies of females obtained from citrus and reared on corn and the progenies of females obtained from bananas and also reared on corn. Because of this fact and the results of cross-inoculation experiments involving citrus, boxwood, calathea, ginger lily, banana and pothos, it was concluded that only one kind of burrowing nema existed in Florida.

The embryonic development of the burrowing nema was described and illustrated. The time required for this development varied from a little over four days to ten days depending on the temperature. A molt occurred in the egg. Three additional molts took place after hatching, coinciding with the periods of major development. The genital primordia of both males and females were identical at hatching, but developed in two different ways according to sex. This made distinction between males and females possible in the late second larval stage.

Burrowing nemas could not survive in water below 0° C. and above 46° C. Aqueous solutions of two and three percent NaCl, KCl and NaNO₃ affected the nemas in an adverse way, mostly temporarily; four percent was lethal. A range from pH 3.7 to pH 9.0 was tolerated by the nemas in vitro.

Fragaria sp., strawberries variety Florida 90 and *Glycine* Max, soybean variety Jackson were established as excellent hosts by inoculation experiments. *Brassica Napobrassica*, rutabaga variety American Purple Top and *Cyperus rotundus*, nutgrass were not infected with burrowing nemas three months after inoculation. The minimum time required to penetrate okra roots was six hours, citrus roots twelve hours. After reproduction had taken place eggs and nemas were found in the cortical tissues of host roots with their longitudinal axis parallel to the root axis.

It was postulated that the resistance of rutabaga to the burrowing nema was based on the plant's ability to interfere with the sensing device of the nema to locate a suitable food source. As a result the nemas died of starvation.

Control of the nemas in vivo was attempted using nematocidal extract from rutabaga. Severe phytotoxicity on citrus rendered these crude compounds impractical for the control of "Spreading Decline."

Microfilm \$2.00; Xerox \$7.00. 149 pages.

AGRICULTURE, ANIMAL CULTURE

SACCHARIN IN BABY PIG NUTRITION

(L. C. Card No. Mic 59-2410)

Stanley Merle Aldinger, Ph.D.
Iowa State College, 1959

Supervisors: Damon V. Catron and
Leslie E. Johnson

Sixteen experiments involving 1335 early weaned baby pigs have been conducted to determine the effect of soluble

saccharin in rations on baby pig performance. The problem was divided into three general categories: the baby pig's preference as determined by free choice selection studies; the baby pig's performance as determined by direct comparison tests; and the changes involved in the blood glucose level as determined by rate of removal of glucose from the blood system. The following points may be summarized from the results and conditions under which these experiments were conducted:

1. Soluble saccharin improved the palatability of early weaned baby pig starter rations as determined by free-choice selection experiments.
2. In free-choice selection studies the use of two feeders per pen instead of five feeders has resulted in less variation in pig response from week to week and between replications.
3. Sugar may be replaced by soluble saccharin as a source of sweetness for baby pig starter rations.
4. Soluble saccharin exerted its maximum response over sugar under conditions of high temperatures and high humidities.
5. High temperature (85° Fahrenheit) and high humidity (70 percent) resulted in larger depressions in baby pig performance than under conditions of high temperature alone.
6. Soluble saccharin and sugar were more effective as appetite stimulants in stale or stored feed (6 months) than in fresh feed.
7. Palatability was more important in the young pig from birth to five weeks of age than it was in the older pig from five to eight weeks of age.
8. Soluble saccharin fed to the young pig generally resulted in an increase in weight gain response.
9. Soluble saccharin has produced a linear improvement in both pig weight gain response and feed required per pound of gain at levels up to four pounds per ton of starter ration.
10. Soluble saccharin was without effect on the blood glucose values of the baby pig as determined by rate of glucose removal from the blood system when fed at levels up to four pounds per ton of starter ration or when injected at the rate of one gram per kilogram of bodyweight.
11. The primary mode of action of soluble saccharin in increasing feed intake appeared to be due to its sweetness.

Microfilm \$2.30; Xerox \$8.20. 176 pages.

PROTEOLYTIC ENZYMES IN BABY PIG NUTRITION

(L. C. Card No. Mic 59-2411)

Roy Oscar Baker, Ph.D.
Iowa State College, 1959

Supervisor: Damon V. Catron

Fifteen experiments involving 2006 pigs were conducted to determine: (1) the ability of the baby pig to utilize soybean protein; (2) the adequacy of the pepsin secretion of the baby pig; (3) factors which cause variations in the response of the baby pigs supplemented with pepsin.

The addition of one percent pepsin (1:3000), pancreatin (U.S.P.), Rhozyme P-11, Rhozyme B-6, and Mycozyme to a Drackett protein-lactose diet improved both growth and feed efficiency of baby pigs. However, the addition of one percent papain to the diet resulted in no improvement in growth.

In 12 observations the supplementation of pepsin to baby pig diets containing soybean protein resulted in an average improvement in growth and feed efficiency of 7.8 and 5.1 percent, respectively. The optimum level of pepsin as determined by growth and feed efficiency of baby pigs was 0.25 percent.

The addition of various levels (0.25, 0.50 and 1.0 percent) of pepsin to a 40 percent dried skim milk diet did not improve the growth or feed efficiency of early weaned pigs.

The feeding of soybean oil meal hydrolyzates to early weaned pigs resulted in an improvement in both growth and feed efficiency. The soybean protein predigested with ficin to 17.5 percent soluble protein showed the most promise in improving the performance of baby pigs.

The tendency for the baby pigs to scour affected their growth response to the supplementation of pepsin. A summary of the trials in which a great deal of "looseness" was observed resulted in a 16.5 percent improvement in growth and 8.1 percent improvement in feed efficiency of early weaned pigs which had received pepsin in the diets. However, there was no difference in the growth of pigs fed diets with or without pepsin in the trials where there was little or no scouring.

In comparison to one-week-old weaned pigs, the pigs weaned at three weeks or older showed little or no improvement in growth from the addition of the pepsin to the ration.

The apparent digestibility of soybean protein by early weaned pigs was determined in two experiments. In the first trial, the addition of 0.25 percent pepsin (1:3000) to the ration of pigs two weeks of age significantly improved the apparent protein digestion from approximately 77 percent for the non-supplemented to 81 percent for the supplemented pigs. There was no improvement in the protein digestion by four-week-old pigs due to pepsin supplementation of the ration. The supplementation of pepsin to the diets in the second experiment resulted in no differences in apparent digestibility of protein by pigs either two or four weeks of age.

The analysis of the stomach tissues of baby pigs for pepsin revealed a significant increase in activity per gram of tissue from birth to eight weeks of age. There were no significant differences, however, in pepsin activity of stomach contents of baby pigs sacrificed from birth to eight weeks of age. Microfilm \$2.50; Xerox \$8.60. 189 pages.

STUDIES ON THE INFLUENCE OF THE RATE OF CHANGES IN AMBIENT TEMPERATURE ON PRODUCTION TRAITS AND MORTALITY OF LAYING PULLETS

(L. C. Card No. Mic 59-1892)

Amado Campana Campos, Ph.D.
University of Maryland, 1958

Supervisor: Assistant Professor Frank Wilcox, Jr.

The influence of the rate at which normal ambient temperature rises or drops to extremely high or low levels on the production traits and mortality of laying pullets was studied. A total of 690 White Leghorns, New Hampshires and Rhode Island Reds were used. The following general procedures were followed: 1) fast (4°F./hr.) and slow (0.5°F./da.) rises in air temperature from 70°-80°F. to extremely high levels, 2) rapid fluctuations in air temperature between 88°F. during the day and 32°F. at night, and 3) fast (2°F./hr.) and slow (0.5°F./hr.) drops in air temperature from 70°-80°F. to extremely low levels.

The results obtained with tests involving high temperatures showed the following:

1. A 24-hour exposure to 100°F. using fast and slow rises in air temperature was found to cause: a) a sudden, equally severe, temporary drop in egg production of the Random-bred White Leghorns and Rhode Island Reds, but caused no effect on the performance of the Maryland strains of White Leghorns and New Hampshires; b) drops in egg weight and shell thickness, which were more pronounced under gradual than under fast rises in air temperature; c) an appreciable increase in albumen height of eggs laid with fast, and to a lesser extent, with slow rises in temperatures; d) a marked reduction in feed consumption, which was slightly greater with fast than with slow rises in temperature; e) a slight drop in body weight of birds exposed to both rates of temperature rise; and f) a slightly greater mortality with fast than with slow rises in temperature.

2. The decline in egg weight, shell thickness and feed consumption, but not egg production, followed closely the rises in air temperature.

3. No appreciable effect on production traits or on mortality of laying pullets was observed with tests involving fluctuations in air temperature between 32° and 88°F. The same was found to be true with tests involving daily rises in temperature to 100°F. for 6 hours, except with shell thickness. These results provide evidence that rate of temperature change alone does not exert a marked influence on most of the production traits and on the mortality of laying pullets.

Results involving low ambient temperatures showed the following:

1. The severity of drop in egg production was found to be influenced greatly by the intensity of sub-freezing temperatures to which the birds were subjected. At 32°F. egg production was not affected, but at 22°, 10° and 0°F., egg production was progressively reduced. The drop in egg production was found to follow closely the drop in air temperature. Heavy breeds were less affected by low temperatures than White Leghorns. Dubbing was observed to minimize the adverse effect of freezing temperatures on egg laying.

2. In addition to the drop in egg production, exposure

to 10°F. resulted in: a) a temporary reduction of shell thickness with both fast and slow drops in temperature, which, however, was not as pronounced as with tests involving high temperatures; b) a marked drop in feed consumption, which was greater with fast than with slow drops in temperature; and c) a noticeable decrease in body weight, which was more pronounced under fast than under slow drops in temperature.

3. Irrespective of the intensity and the rate with which the air temperature was dropped, the size and albumen quality of the eggs laid were not affected.

4. A direct relationship was found to exist between comb height and severity of frostbite. White Leghorns were found to be more susceptible to frostbite than heavy breeds, probably because of their large combs. One White Leghorn (RB) pullet bled to death as a result of a comb injury.

Microfilm \$2.00; Xerox \$4.60. 88 pages.

AN INVESTIGATION OF THE METHIONINE AND CYSTINE CONTENT OF POULTRY MEAT

(L. C. Card No. Mic 59-1617)

Jack Leroy Fry, Ph.D.
Purdue University, 1959

Major Professor: W. J. Stadelman

This study was planned to determine the effect of various factors on the methionine and cystine content of poultry meat. The three main factors investigated were distribution of the amino acids in the carcass; cooking; and different levels of dietary dl-methionine. Included in the cooking study was a consideration of the bird to bird variation. All assays were made microbiologically using commercially prepared media with *Leuconostoc mesenteroides* P-60 as the test organism. A preliminary study consisted of determining the optimum time and method combination for the hydrolysis of the fat-free, moisture-free poultry meat samples. This study also compared turbidimetric and acidimetric determinations.

A six hour sealed tube hydrolysis with 3 N HCl has been found satisfactory for the assay of methionine and cystine. Where separate hydrolysates are preferred, 4 hours for cystine and 8 hours for methionine are recommended. Turbidimetric determinations at 20 hours of incubation were less satisfactory than acidimetric titration after 72 hours of incubation.

The various parts of the chicken carcass differ significantly in their content of methionine and cystine. Light meat is highest in methionine with 2.97 grams per 16.0 grams of nitrogen. Cystine is contained in largest amounts in the liver, the level being 2.12 grams per 16.0 grams of nitrogen. Skin was lowest in both amino acids.

Methionine and cystine were found to be stable to cooking. The "drip" lost during cooking includes gelatin which is relatively low in methionine and cystine. Thus cooking changed the proportion of the remaining amino acids, and methionine and cystine, as a percentage of the nitrogen present, actually increased. Individual bird to bird variation was not significant.

The supplemental levels of 0%, .05% and .5% dietary dl-methionine had little effect on the methionine or cystine

content of poultry meat. Probably related to feathering, cystine was affected by age, the six week old birds having less muscle cystine than the nine and twelve week old birds. Microfilm \$2.00; Xerox \$4.40. 82 pages.

STUDIES OF TRANSMISSIBLE GASTROENTERITIS OF SWINE

(L. C. Card No. Mic 59-1618)

Edward Omer Haelterman, Ph.D.
Purdue University, 1959

Major Professor: L. M. Hutchings

This thesis is concerned with three phases of study of transmissible gastroenteritis of swine (TGE). The first is with observations of naturally occurring outbreaks in an effort to describe the disease as it occurs in the field, to determine means by which it spreads and to observe the efficiency of several control procedures. The second deals with the inoculation of species other than swine, primarily to find whether they might be instrumental in the dissemination of the disease and third with observations and experimental work on a relatively mild type of infectious diarrheal disease of baby pigs which is closely similar to, but distinct from TGE.

Of 139 outbreaks of TGE reported to the Purdue University Veterinary Science Department from 1950 to 1956, 91 per cent occurred between late December and April with a peak of incidence during February and March.

Factors which appear to contribute to this seasonal incidence are crowding of pigs and increased survival time of the virus during cold weather.

Of 15,774 infected suckling pigs in 96 herds in which mortality figures were obtained, 10,025 or 63.4 per cent died. The main factor influencing mortality was age at infection. This, in turn, was influenced in some degree by the type of housing. The most severe losses occurred in central farrowing houses in which infection spread to pigs shortly after birth.

None of many medicinal treatments had any beneficial effect on pigs infected in the first few days of life but treatment directed toward secondary bacterial infection may have decreased the severity of the disease in some older animals.

TGE in pregnant sows did not appear to have any effect on pigs in utero.

Although no satisfactory explanation was apparent for the introduction of the virus into the majority of clean herds, there was good evidence in some that the disease had been carried in by contaminated feed, by personnel moving between herds, by stock trucks and by acutely infected swine. Little or no evidence was found in the study of histories of herds before and after outbreaks for the existence of swine that shed the virus for more than six weeks.

Satisfactory control methods were based either on isolation of susceptible from infected swine or the establishment of immunity by deliberate infection of sows. The choice of procedure depended upon the schedule of farrowing and facilities available.

Four species; dogs, cats, mice, and rabbits were

inoculated orally with TGE virus and attempts were made to recover the virus from stools or viscera. None of these animals showed clinical evidence of disease. Virus was not found in the stools of rabbits or in the viscera of mice killed at daily intervals after inoculation. The virus was recovered from the pooled feces of four kittens on the third, but not on the first, second, fourth, or seventh day after inoculation.

TGE virus was recovered from the pooled feces of four twelve-week-old dogs on all of the first seven days after exposure, but not on the 14th or 21st. A neutralization test showed that the dogs developed homologous antibody after infection. When the same dogs were inoculated again 50 days later, no virus was recovered from their stools. Inoculation of eleven-day-old pups did not result in clinically recognizable infection. The specific virus was recovered from the stool of a dog on a farm where TGE was present. These results indicated that the dog can be infected with TGE and could be instrumental in its dissemination.

An infectious diarrheal disease of baby pigs, similar to TGE with respect to symptomatology, but much milder in nature was observed in Indiana. The disease was transmitted serially to baby pigs by oral inoculation of filtrates and antibiotic-treated extracts of intestinal tract. The experimentally produced disease was afebrile, characterized by vomiting, diarrhea, and anorexia of one to five days duration and followed by apparently complete recovery of all of the experimental animals. Pigs that recovered from this condition were still susceptible to TGE and vice versa. Neutralization tests indicated that this agent was neutralized by serum of recovered pigs but cross neutralization tests with TGE were inconclusive.

Microfilm \$2.15; Xerox \$7.60. 162 pages.

MEASUREMENTS OF COMPONENT HEAT LOSSES OF POULTRY

(L. C. Card No. Mic 59-1624)

Kenneth Allan Jordan, Ph.D.
Purdue University, 1959

Major Professor: Alvin C. Dale

Scientists and engineers have long studied the problem of the heat production of animals. Their studies have, of course, been limited by the tools available and by the particular discipline of the experimenter. To further the study of the environmental effects of this problem, an apparatus and method were developed. While final solutions have not been possible, this study helps clarify the problem and defines aspects of the problem that still must be resolved.

The apparatus developed was a gradient layer calorimeter designed to measure the component heat losses (radiation and convection) of poultry. The inside surface of the calorimeter was lined with two thermopiles, which were used to measure the heat flow. A gradient layer thermopile was used to determine the total sensible heat. A four-pi radiometer thermopile was used to determine the radiant component of heat loss. Air was circulated through the calorimeter to maintain normal conditions for

animal metabolism. The inlet air temperature was maintained equal to outlet air temperature.

The design aimed toward the solution of environmental factors affecting sensible heat losses of chickens. Considerable attention was given to the errors involved in each design decision and to the calibration of the calorimeter. It was possible to measure the radiant heat loss with an error of less than two British Thermal Units per hour. The total sensible heat loss was measured with an error of less than one British Thermal Unit per hour. Calculations indicated that the radiometric thermopile was insensitive to the convective heat transfer.

The latent heat component was found by condensing the moisture evaporated in the calorimeter. More research will be required before this part of the system can be considered entirely satisfactory.

Individual tests were run with seven chickens. The results were used to determine the validity of the measurement.

Under test conditions, sixty percent of the heat loss in active chickens was due to radiation. When the chickens were resting, this percentage increased to approximately 80%. Because the air temperature has no direct effect on the radiation losses, it is proposed that the radiation component receive more attention in building design.

The three principal conclusions of this study are the following:

1. It is possible to measure continuously the sensible components (radiation and convection) of heat transferred from a chicken with an error of less than two British Thermal Units per hour.
2. In the design of buildings for animal comfort, consideration should be given to the surface temperatures, since sixty percent of the sensible heat loss was transferred by radiant energy.
3. Heat losses of animals can be continuously measured by gradient layer calorimetry as inexpensively as the continuous measurement of heat production by gas analysis.

The principal recommendations are as follows:

1. The study of the adaption of the chicken to variable environmental conditions should be postponed until the environmental effects upon the component heat losses (radiation, convection, and latent) have been formulated.
2. Components of sensible heat loss should be studied with the apparatus designed. A statistical experimental design is presented in this thesis and can be used to separate the environmental effects upon the radiant component and the convection component.
3. Latent heat losses should be studied by other techniques.

Microfilm \$2.00; Xerox \$6.40. 132 pages.

STUDIES ON THE EFFECT OF SELENIUM AND OTHER FACTORS ON VITAMIN E DEFICIENCY IN THE CHICK

(L. C. Card No. Mic 59-2470)

Malden Charles Nesheim, Ph.D.
Cornell University, 1959

Studies were conducted on the nutritional relationships of selenium and other factors to vitamin E deficiency diseases in the chick.

Selenium, at levels as low as 0.08 mg. per kg. of diet, prevented exudative diathesis in chicks when added to vitamin E deficient diets containing either torula yeast, isolated soybean protein, or crystalline amino acids. Injected selenium also was effective against exudative diathesis.

Selenium was necessary for maximum growth of chicks receiving diets containing torula yeast, whether vitamin E was present or absent. The presence of vitamin E reduced the amount of added selenium needed to produce maximum growth. Levels of selenium as low as 0.04 mg. per kg. of diet were adequate when vitamin E was present.

Attempts to demonstrate a specific requirement for selenium without using diets that contained torula yeast were unsuccessful. Either vitamin E or selenium prevented exudates that occurred when these diets were fed, but no growth improvement was obtained from added selenium when the diets contained adequate vitamin E. Diets were used in which the protein was supplied by either (1) isolated soybean protein, (2) alkali purified isolated soybean protein, (3) part isolated soybean protein and part amino acids or (4) crystalline amino acids. It was not possible to reduce the selenium content of these diets below 0.04 mg. per kg. of diet, and this amount appears to satisfy the selenium requirement of the chick when the diet contains sufficient vitamin E.

Selenium was partially effective against muscular dystrophy produced in chicks by feeding diets deficient in vitamin E and sulfur containing amino acids. Vitamin E, methionine, or cystine, added singly, completely prevented muscular dystrophy in chicks fed these diets.

Methyl donors other than methionine, such as choline and betaine, did not prevent muscular dystrophy. Sulfhydryl containing compounds such as sodium thioglycolate and 2,3-dimercaptopropanol (BAL) also did not prevent muscular dystrophy and were toxic to the chick. Preliminary evidence indicates that 2-mercaptoethylamine as a substitute for cystine may be effective against this disorder.

A deficiency of the creatine precursors, arginine and glycine, did not result in muscular dystrophy. The creatine content of chick breast muscle was reduced more by a deficiency of creatine precursors than by muscular dystrophy. A deficiency of arginine actually prevented the development of muscular dystrophy. This was not merely due to impairment of growth, since when growth differences were controlled by paired-feeding, only those chicks receiving adequate arginine developed muscular dystrophy.

Studies on the composition of dystrophic muscles indicated that muscular dystrophy results in a lowered dry matter, creatine and potassium content and an increased sodium content of breast muscle as compared to those of normal chicks. When creatine and potassium values were expressed on a dry matter basis, little difference was

found in the levels of these constituents in normal and dystrophic muscles.

The activity of the enzyme, phosphorylase, is decreased in dystrophic breast muscle as compared to breast muscle of chicks receiving vitamin E. Glycogen levels also were lowered in white muscle of chicks with muscular dystrophy but were not changed in the red muscle of these chicks.

These experiments indicate that selenium is an essential trace element for the chick and further demonstrate the complex dietary etiology of vitamin E deficiency diseases in this species.

Microfilm \$2.00; Xerox \$5.60. 113 pages.

THE APPARENT DIGESTIBILITY OF THE PROTEIN AND DRY MATTER OF HIGH-PROTEIN AND STANDARD HYBRID CORN SILAGES

(L. C. Card No. Mic 59-2054)

Gilbert Horace Rollins, Ph.D.
University of Illinois, 1959

The apparent digestibility of the protein and dry matter contained in corn silages of varying protein contents was studied. Digestion trials and nitrogen retention studies were carried out in two separate experiments with rabbits and with steers using the total collection method with 10-day collection periods. Twelve New Zealand White, mature, female rabbits were employed in a 3 x 3 Latin square design experiment to compare silages made from U. S. Hybrid 13 corn, Lowe medium protein corn and Illinois High Protein corn. The silages were dried to air dryness, ground finely and compounded into similar rations which were fed *ad libitum*. The protein content (on a dry basis) of the rations, designated with respect to the kind of silage each contained, were U. S. Hybrid 13, 7.89%; Lowe medium protein, 8.30%; and Illinois High Protein, 10.00% and 10.10%, respectively, for two rations containing two different lots of the same silage. In a reversal trial, fresh silages made from U. S. Hybrid 13 corn and Illinois High Protein corn were fed to two Holstein steers, approximately eighteen months old and weighing approximately 1000 pounds. On a dry-matter basis, the U. S. Hybrid 13 silage contained a mean crude protein content of 7.76% compared to that of 11.75% for the Illinois High Protein silage.

The results with rabbits, when analyzed by analyses of variance, revealed that the mean apparent digestion coefficients of the dry matter in the U. S. Hybrid 13 ration (55.25%) and the Lowe medium protein ration (55.56%) were significantly higher at the 5% level than that of the Illinois High Protein ration (47.87%). The apparent digestion coefficients obtained for the protein in these rations were, in the order of their mention above, 48.14%, 49.07% and 53.99%, respectively. These differences were not significant. However, the response values obtained for the rabbits were not uniform.

With steers, the mean apparent digestion coefficient of the protein in the Illinois High Protein silage (60.13%) was significantly higher at the 5% level than that of the U. S. Hybrid 13 silage (47.76%). The mean dry-matter apparent

digestion coefficient for the U. S. Hybrid 13 silage was 66.87% compared to that of 65.28% for the Illinois High Protein silage. This difference was not significant. The digestible protein contained in the Illinois High Protein silage was significantly greater at the 1% level of probability than that of the U. S. Hybrid 13 silage.

Illinois High Protein corn silage has been shown to provide more digestible protein per pound of dry matter than silage made from a commonly grown lower protein corn hybrid. It is assumed, on the basis of the known composition of the protein of the corn plant, that the use of Illinois High Protein corn silage is a satisfactory way of supplying a considerable portion of the protein needed by mature dairy cattle, and that such use might reduce the need for purchased supplemental feeds below the amount needed when silage from commonly grown hybrids is fed.

Microfilm \$2.00; Xerox \$3.60. 61 pages.

AGRICULTURE, FORESTRY AND WILDLIFE

SYNECOLOGICAL COORDINATES IN FOREST CLASSIFICATION AND IN REPRODUCTION STUDIES

(L. C. Card No. Mic 59-2346)

Egolf Voldemars Bakuzis, Ph.D.
University of Minnesota, 1959

Adviser: Henry L. Hansen

This study attempts to trace the emergence of a new major method in synecology, the method of synecological coordinates. The study consists of three parts, and it pays particular attention to the role of synecological coordinates in forest classification and reproduction studies.

The first part covers the historical analysis by the major areas of scientific activity and discusses the present situation in forest synecology.

The very origin of the method can be linked with the arrangement of species in groups or sequences according to the requirements or adaptability to certain factors. However, conscious development of the method was started only a few decades ago by two Russian schools: the Ukrainian or forest ecological school led by Pogrebnjak, and by Ramensky, a member of phytocenological school. Somewhat later in the United States there appeared the "ordination method" initiated by the Wisconsin school under the leadership of Curtis. In Canada, Hills developed a physiographic approach to synecological coordinates. New working groups and individuals are rapidly joining the movement in different parts of the world. The major issues at present are the choice of the basic coordinates and determination of the synecological values. Predominantly the choice covers the subtotals forming the matter-energy budget in ecosystems: moisture, nutrients, (aeration), heat, light, (and mechanical force). Most of the work is done with moisture and nutrient regimes and some sub-factors of these complexes. Synecological coordinate values are determined in many different ways, but at present relative estimates from vegetational or physiographic indicators predominate. However, specific experimental methods are already initiated.

Some authors are convinced that the ultimate goal of synecological coordinates is to replace the present classification methods. In this study it is concluded that the major forest synecological classification methods have no basic differences and can be reconciled on the principles of ecosystem. The technical differences of these methods are advantageous adaptations to regional conditions. Synecological coordinates can aid the further evolution of the different methods. In addition, synecological coordinates can aid in solving chorological (plant geographical) problems and assist directly in solution of a number of theoretical and practical forestry problems.

The second part presents a reorganization of the forest synecological classification system of Latvia in the framework of moisture-nutrient coordinates. Attention is paid to the configuration of the edaphic field (edaphic site complex), which greatly resembles the triangular configuration of the primary succession schemes as developed by the American ecological school, and presented inadvertently in many figures by the Ukrainian school and other sources.

The essence of the second part is an analysis of the dynamics of natural reproduction on clearcutting strips from 443 sampling areas with the aid of moisture-nutrient coordinates. For a better approach to the complexity of the problem synecological coordinates are used in combination with rectangular coordinates, common (static) triangular coordinates and originally developed "expanding" (dynamic) triangular coordinates. Dynamic triangular coordinates have one of their axes reversed, which allows for solutions of some specific complicated chronological and spatial problems.

The third part analyzes 356 Minnesota forest communities with the aid of moisture, nutrient, heat and light coordinates. Coordinate values are established for separate species evaluating previously published information and adjusting to the survey data. Community values are computed upon the basis of species presence. The approximate triangular form of the edaphic field was reaffirmed, and for the first time an idea on the configuration of other synecological fields (two-dimensional site complexes) and spaces (three and four-dimensional) was obtained. Regional changes in the synecological fields within Minnesota were determined. The place of forest species (ecographs), cover relationships and physiographic changes within synecological fields were investigated.

Microfilm \$3.25; Xerox \$11.20. 252 pages.

REDUCTION OF WHITEFISH POPULATIONS IN AN ADIRONDACK SALMON LAKE: AN EFFORT TOWARDS INCREASED PRODUCTION OF YOUNG

(L. C. Card No. Mic 59-2471)

Paul Christian Neth, Ph.D.
Cornell University, 1959

Between 1952 and 1956 an experimental program was directed at control of substantial adult populations of common whitefish and round whitefish already existing in Little Moose Lake, New York. The former species showed severe growth stagnation that was presumed to result from interspecific or intraspecific competition. In theory, control could reduce the effectiveness of density-dependent

compensatory types of mortality, resulting in increased production of young of these two species which might serve as food for larger landlocked salmon.

During the five year period, 1448 common whitefish weighing 4153 pounds, 2751 round whitefish weighing 1881 pounds, and an additional 4818 rough rish (mainly suckers and bullheads) weighing 1711 pounds, were removed from the lake.

Effects of the control program were most evident on the species directly controlled. Common whitefish were 3 per cent longer and 23 per cent heavier and round whitefish 4 per cent longer and 16 per cent heavier in 1956 than in 1952. The population of common whitefish was reduced from an estimated 2600 in 1952 to 800 in 1956. Reduction in the adult population was greatly assisted by the fortuitous failure of several year classes in 1948-51. None of the evidence obtained indicated increased production of young whitefishes during the period of this study. However, the actual effect of exploitation on the production of young was clouded by poor natural reproduction which was already in existence when the control program was initiated.

Microfilm \$3.00; Xerox \$10.40. 232 pages.

AGRICULTURE, PLANT CULTURE

THE GROWTH AND DEVELOPMENT OF EMBRYO AND ENDOSPERM IN RELATION TO SEED ABORTION IN CERTAIN TETRAPLOID APPLES

(L. C. Card No. Mic 59-1999)

Mary Price Aubertin, Ph.D.
University of Illinois, 1959

The normal embryogeny of Wrixparent and Giant Yellow Transparent, which are both diploid-tetraploid-tetraploid periclinal chimeras of the diploid apple variety Yellow Transparent, was not found to differ markedly from that described in other varieties in the literature. Fertilization occurred in terminal flowers three and one-half days after pollination and not until seven and eight days after pollination in lateral flowers. Diploid Jonathan pollen effected fertilization about a day before tetraploid Jonathan pollen did. In diploid-pollinated embryo sacs the first division of the primary endosperm nucleus occurred eight days after pollination but a day later in tetraploid-pollinated embryo sacs. Two- and three-celled proembryos accompanied by fifteen to thirty naked endosperm nuclei were observed eleven days after pollination in diploid-pollinated embryo sacs. Fifteen days after pollination in both diploid- and tetraploid-pollinated embryo sacs there were two- and three-celled proembryos and approximately sixty endosperm nuclei. A transition from naked endosperm nuclei to cellular endosperm was observed forty days after pollination in Giant Yellow Transparent embryo sacs. Club-shaped proembryos were found at this time in diploid-pollinated embryo sacs, and in tetraploid-pollinated embryo sacs there were heart- and spatulate-shaped proembryos. Mature embryos were found sixty-nine days after pollination in both diploid- and tetraploid-pollinated embryo sacs.

Several factors thought to contribute to the high rate of seed abortion in Wrixparent and Giant Yellow Transparent were found. Egg breakdown occurred as early as eighteen hours after pollination as result of low flower vigor and as late as nine days after pollination as a result of lack of fertilization. Swollen and crooked tetraploid pollen tubes found suggest a possible incompatibility between tetraploid Jonathan and Wrixparent. Embryo degeneration accompanied by arrested endosperm development was found eleven days after pollination in Wrixparent. The observation that abortive seeds of gradually increasing size could be found in tetraploid apples all during the growing season seems to indicate that seed abortion in these apples continues over a rather long period instead of being confined to a particular stage of development.

Seed germination was found to be higher in crosses involving diploid pollen than in crosses involving tetraploid pollen. Microfilm \$2.00; Xerox \$3.00. 54 pages.

THE RESPONSE OF ONE-YEAR-OLD TUNG TREES TO RATES AND PLACEMENT OF ZINC AS AFFECTED BY SELECTED SOIL SERIES

(L. C. Card No. Mic 59-1722)

Harold L. Barrows, Ph.D.
The University of Florida, 1959

A field experiment was designed to study the effect of soil type, levels and placements of zinc sulfate on the growth and accumulation of zinc in one-year-old tung trees, and the movement of zinc in the soil. The soils tested were: Savannah fine sandy loam, Red Bay fine sandy loam, Lakeland fine sand, and Arredondo loamy fine sand. The treatments consisted of a check plot and the factorial combination of three levels of zinc sulfate; 1, 2, and 4 ounces per tree, with three placements. Surface: applied on the surface of the soil, Cylinder: mixed with three cubic feet of soil in the rooting zone, and Trench: mixed with an equal volume of soil in a circular trench surrounding the cylinder placement. A pot experiment was conducted to study the influence of soil type and horizon on the toxicity level of zinc sulfate to tung seedlings. Levels of zinc sulfate up to 300 ppm. of zinc were mixed with A₁ and A₂ horizons of Lakeland fine sand, and up to 400 ppm. were mixed with comparable horizons of Arredondo loamy fine sand.

In the field experiment, total growth and feeder-root concentration were reduced on all but the Arredondo soil by the cylinder placement. Data obtained from the pot experiment indicated that top and root growth increased when zinc in the leaves was increased up to 0.77 me/100 g. At concentrations above this, top growth was reduced followed by a reduction in root growth.

Leaves collected from the trunks of the trees had a higher concentration of zinc and provided a more sensitive measure of zinc uptake than leaves collected from the laterals. Zinc uptake, as measured by leaf analysis, was highest when the high level of zinc was mixed in the cylinder placement. The concentration of zinc in the roots was about ten times the concentration found in the leaves.

The results of the leaf and root analyses revealed a significant magnesium x zinc interaction. Some probable mechanisms involved in this interaction are discussed.

The results of the soil analyses show that zinc moved readily through the Lakeland soil, but was immobilized in the Arredondo soil. The rate of zinc movement through the four soils was in the order Lakeland > Red Bay > Savannah > Arredondo. The differences in mobility were associated with a combination of factors including content and nature of the clay mineral, organic matter and phosphate content, and soil pH. It was found that very little zinc was absorbed by the trees from surface applications on the Arredondo soil, but the trees could obtain sufficient zinc when the zinc was mixed with the soil. This is explained by the fact that the greatest concentration of feeder roots was found within a radius of 12 inches from the tree and at a depth of 6 to 12 inches, and the rate of zinc movement from the surface application on the Arredondo soil was not adequate to supply sufficient zinc to the trees. In contrast, zinc mobility on the Lakeland soil was such that 1 ounce applied on the surface proved to be toxic to the trees.

Although there was little lateral movement of zinc in the soils, the movement was primarily in the direction of the tree rather than away from it. This was explained on the basis of moisture movement and an exchange mechanism involving the roots.

On the basis of these experiments, recommendations are made for supplying adequate zinc to young tung trees planted on the four soils tested.

Microfilm \$2.00; Xerox \$7.00. 149 pages.

MOLYBDENUM STUDIES WITH APPLE AND TOMATO IN NEW JERSEY

(L. C. Card No. Mic 59-1815)

Carlos Enrique Fernández, Ph.D.
Rutgers University, 1959

Major Professor: Dr. Norman F. Childers

This study was divided into two phases. The first part consisted of the development of molybdenum deficiency in Rome Beauty apple seedlings, a bio-assay technique for molybdenum, and a survey of the molybdenum status of New Jersey apple orchards. The second part was concerned with some of the effects of molybdenum on tomato plants and fruits.

Molybdenum deficiency symptoms were induced in apple seedlings by growing them in nutrient solutions free of molybdenum for about eighteen months. The symptoms are described as a general chlorosis of the young leaves followed by marginal scorching of the lowest leaves. Nitrates accumulated in the leaves and molybdenum was found at concentrations of 0.05 ppm. in comparison with 0.16 ppm. for those receiving Mo. The growth of the deficient plants was reduced.

A bio-assay technique for Mo using *Aspergillus niger* as a test organism is described. This technique allows the determination of very small amounts of Mo and consequently the use of very small tissue samples.

Making use of this bio-assay, analyses were made of leaf samples taken from one hundred apple orchards distributed throughout New Jersey. The results were correlated with previously available information on these same orchards. July seems to be the most appropriate month for sampling apple leaves with the purpose of studying Mo

nutrition. The Mo content of the leaves in this month was found to be positively correlated with soil pH and negatively correlated with soil and leaf Mn. The orchards of some counties gave consistently low values throughout the season.

In the second phase of the study, tomato plants were grown in nutrient solutions with four levels of Mo (0.0, 0.0001, 0.001, and 0.01 ppm.). It was found that even at very low levels of supply (0.0001 ppm.) tomato plants grew apparently normal and the vitamin C content of the juice was not affected, although the Mo concentration in the tissues was approaching that of the plants not receiving Mo at all. The plants not provided with Mo showed the typical symptoms of deficiency described by other workers and did not set fruit.

Microfilm \$2.00; Xerox \$3.00. 46 pages.

DEFOLIATION OF OATS AND PEARLMILLET AS RELATED TO HERBAGE YIELD

(L. C. Card No. Mic 59-1726)

Carl Soren Hoveland, Ph.D.
The University of Florida, 1959

Arlington, Floriland, and Seminole varieties of oats (*Avena sativa* L.), having decumbent, intermediate, and erect growth habits respectively, were subjected to various cutting treatments in both irrigated and unirrigated field studies during the winters of 1955-56 and 1956-57 at Gainesville, Florida. Plants were cut when they reached heights of 18, 12, and six inches in combination with stubble heights of nine, five, and two inches. Decumbent forage was lifted into an erect position to determine its true height and for the cutting operation.

The behavior of pearl millet (*Pennisetum glaucum* (L.)) under differential cutting treatments was studied in field experiments over the four year period 1955-58. Plants were cut when 54, 30, 18, and 12 inches in height leaving stubbles of 18, 10, six, and four inches. The effects of row spacing, irrigation, planting date, and nitrogen level were also studied.

Forage yields of the three oat varieties were sharply reduced by clipping at a height of six inches. Dry matter yields under both irrigated and unirrigated conditions were generally doubled by allowing plants to grow 12 inches tall before cutting, regardless of growth habit. Seminole was the only variety more productive when cut at 18 inches in height. Root development was also seriously curtailed by close, frequent defoliation. Clipping at 12 inches in height provided more forage during the midwinter period. Close clipping did not directly reduce the forage yield of oats but resulted in heavy stand losses where oats had been clipped or grazed to leave a one- or two-inch stubble just prior to a freeze.

Irrigation did not increase yields of pearl millet but was useful in stimulating oat production early in the winter. This beneficial effect was erased by clipping oat plants when they were only six inches tall.

The dry matter production of pearl millet was generally in inverse proportion to the frequency of defoliation. Plants in 38-inch rows cut when 54 inches tall produced the most dry matter but with a closer row spacing of seven

or 19 inches, the dry matter yields of 30-inch plants of the Starr variety were nearly as large. Forage and root production of both common and Starr millet cut at a height of 12 inches were about half that of 30-inch plants.

Stubble height had little or no effect on total dry matter production of pearl millet plants 30 inches or less in height at lower levels of nitrogen fertilization. With larger nitrogen applications, a stubble height of 10 inches was more productive. The crude protein content of forage from 30-inch plants with a 10- or 18-inch stubble was somewhat higher than for plants with a four-inch stubble.

Higher forage yields of pearl millet resulted from row spacings of seven and 19 inches than from 38-inch rows. Plants in seven-inch row spacings contained slightly less crude protein and generally did not remain productive as long as wider spacings.

The date of planting, varying from March to August, was one of the most important factors in determining forage yield of pearl millet. Total dry matter production was highest from March and April seedings with a steady decline in yield for each month of delay in planting. Plants from the early dates of planting generally remained productive as long as those seeded in midsummer.

Numbers of live shoots on pearl millet decreased during the growing season, irrespective of cutting treatments. The reduction in numbers of shoots was greatest under high nitrogen fertilization.

Microfilm \$2.45; Xerox \$8.40. 185 pages.

THE PHOSPHORUS COMPOSITION OF WHEAT GRAIN AS INFLUENCED BY RESIDUAL PHOSPHATE TREATMENTS

(L. C. Card No. Mic 59-2027)

Muhammad Iqbal, Ph.D.
University of Illinois, 1959

The residual effect of broadcast phosphate treatments and the combined effect of the residual and new treatments on the composition of wheat grain were determined by grain analysis. The phosphorus percentage of wheat grain increased with increase in the residual phosphate treatments. The relationship between the phosphorus composition of wheat grain and the residual and new phosphate treatments may be expressed by a Mitscherlich type equation as follows:

$$\log (A-y) = \log A - c_1 b_1 - c_r x_r - c_x$$

where A is the maximum per cent phosphorus in the grain, y is the per cent phosphorus in wheat grain when b_1 pounds of phosphorus, as measured by the P_1 test, and x_r pounds of residual P_2O_5 are present in the soil, and x pounds of P_2O_5 per acre are added. The terms, c_1 , c_r , and c_x , are efficiency factors for b_1 , x_r , and x, respectively. The values for A, c_1 , and c_x , established in an earlier study by Balba and Bray (1956a,b), were verified and were found to hold as well or better for the data of the present study when all the essential conditions were kept constant as in the previous study.

The soil test values for the previously treated plots increased with increase in the residual treatments. Although the soil tests did not detect any such effect at lower

levels, yet the grain composition increased and clearly exhibited this effect in nearly all cases. The Mitscherlich equation, with necessary modifications, was used to express the relationship of the available soil phosphorus, as measured by the P_1 soil test, to the phosphorus composition of wheat grain. Following are the equations proposed for this purpose:

$$\log (A-y) = \log A - c_3 \log b_3$$

$$\log (A-y) = \log A - c_1 b_1 - c_2 \log b_2$$

where b_1 is the soil test of the untreated plot, b_3 is the soil test one year after the fertilizer was applied, and b_2 is the increase in the P_1 test value ($b_3 - b_1$). The terms, c_1 , c_2 , and c_3 , are the efficiency factors for b_1 , $\log b_2$, and $\log b_3$, respectively. Values for these new constants were established, and the equations were used to calculate the approximate phosphorus percentage in the wheat grain. The equations were found statistically to be good estimators of the observed phosphorus composition of the grain.

The proposed equations provide varied information in the field of soil fertility. They not only help in calculating the approximate phosphorus composition of wheat grain, but also in determining the status of the contributing sources of soil phosphorus through grain analysis. The efficiency factors established can be used as a means for evaluating quantitatively the relative effectiveness of various forms of the nutrient, or the effectiveness of one form under different conditions. It was found that the year-old application of phosphate fertilizer is roughly half as effective as the new one. Contribution of each source of soil phosphorus towards the build-up of grain composition can also be calculated.

Microfilm \$2.00; Xerox \$4.80. 92 pages.

SOME NUTRITIONAL ASPECTS OF IRRADIATED AND NONIRRADIATED SPORES OF *BACILLUS COAGULANS*

(L. C. Card No. Mic 59-1623)

Karl Robert Johnson, Ph.D.
Purdue University, 1959

Major Professor: G. R. Ammerman

An evaluation of cathode and gamma rays as a source of radiation was made. Growth rates and nutritive requirements for *Bacillus coagulans* (NRS 770) were not found to be related to the type of radiation.

An irradiation death time curve was determined for spores of *Bacillus coagulans* (NRS 770) using both the Purdue Linear Electron Accelerator and a spent reactor fuel element source at Argonne National Laboratory.

Nutritive studies relating radiation to the requirements of the test organism to biotin, thiamine and nicotinic acid were made. In all cases the culture grown from irradiated spores responded more to added vitamins than the non-irradiated.

The uptake of biotin from the culture was related to the increase in growth of the culture grown from irradiated spores.

There was no detectable increase in glucose uptake as related to increase growth in cultures grown from irradiated spores. Microfilm \$2.00; Xerox \$4.60. 89 pages.

THE INFLUENCE OF TEMPERATURE AND MOISTURE ON SOIL PHOSPHORUS AS CHARACTERIZED BY PLANT UPTAKE AND CHEMICAL FRACTIONATION

(L. C. Card No. Mic 59-1629)

Alexander Ross Mack, Ph.D.
Purdue University, 1959

Major Professor: Dr. Stanley A. Barber

This research was conducted to investigate soil moisture and temperature as two of the environmental factors affecting soil phosphorus availability for plant growth. Previous field observations had indicated that these two factors were associated closely with crop response to applied fertilizer and yield data from fertility plots had shown that the relative yields of phosphate deficient plots had varied from year to year. These observations suggested that the availability of phosphorus in the soil was varying from year to year and that the availability to plants may be associated with temperature and moisture of the soil either prior to or during growth of the plant.

To investigate the effect of temperature and moisture on soil phosphorus availability, biological and chemical analyses were made. German millet was grown under combinations of moisture and temperature conditions in the greenhouse and in climate-control rooms to determine the uptake of phosphorus from soil and from nutrient solutions. Soil was preconditioned for several months at different moisture and temperature levels to determine the effect of these factors on phosphate availability prior to cropping. The availability was measured by taking the dry weight and the phosphate uptake for the phosphate deficient soil as a per cent of that for the phosphate sufficient soil. The effects of temperature and moisture on changes in the soil phosphate fractions were determined by chemical analyses.

Evidence from this investigation indicated that moisture, temperature and leaching affected the availability of phosphorus for plant growth and the phosphorus fractions in the soil. A rise in soil temperature prior to cropping increased the phosphorus available for the subsequent plant growth. An increase in the moisture content, between 30 and 100 per cent of field capacity, increased the available phosphorus during cropping at the higher soil temperature but not at the lower soil temperature. A change in the moisture content between 30 and 100 per cent of field capacity had a negligible effect on soil phosphorus availability prior to cropping. An increase in soil temperature increased the yield of plant material, phosphorus uptake and the relative availability of phosphorus.

Leaching the soil with water under aerobic conditions decreased the acid-soluble phosphate, increased the iron phosphate (alkali-soluble) and tended to decrease the aluminum phosphate fraction. Moisture in excess of field capacity under partial anaerobic and non-leaching conditions increased the acid-soluble phosphate content but

decreased the amount available for plant growth. An increase in temperature during leaching increased the amount of water-soluble phosphate leached. The amount of phosphate leached from previously frozen soil was greater than from soil not previously frozen. These effects of temperature on leached soil continued for 550 hours of leaching at a rate of 1.1 acre inches of water per hour.

It is concluded from the results that the phosphate fractions in the soil are more subject to change when the moisture content is near field capacity. Under aerobic (oxidizing) conditions the iron phosphate is in a ferric state and is not readily acid-soluble, whereas, under partial anaerobic (reducing) conditions it is in a ferrous state (and is more readily acid-soluble). It is also concluded that during freezing of soils, the phosphate compounds are either changed or that the surface area of those present is changed.

An analysis of the meteorological data and of winter wheat response to phosphate fertilizers under field conditions on the Purdue Agronomy Farm for the years 1953-1958 was made.

It indicated that the relative response to phosphorus was greater when the mean temperature and precipitation for May were below normal than when the mean temperature and precipitation were above normal.

Thus, field and laboratory research tend to corroborate the hypothesis that temperature and moisture greatly influence the availability of soil phosphorus to plants.

Microfilm \$2.25; Xerox \$8.00. 172 pages.

A CYTOGENETIC STUDY OF CERTAIN INTERSPECIFIC AVENA HYBRIDS, AND THE INHERITANCE OF RESISTANCE IN DIPLOID AND TETRAPLOID VARIETIES TO RACES OF CROWN AND STEM RUST

(L. C. Card No. Mic 59-2364)

Harold Gene Marshall, Ph.D.
University of Minnesota, 1959

Adviser: W. M. Myers

The races of crown rust attacking varieties with the Landhafer or Santa Fe resistance have posed a serious potential threat to oat production since the discovery of the first of these so-called "Landhafer races" during 1953. The importance of the genes for resistance to these races carried by diploid and tetraploid *Avena* species has been pointed out by various workers.

This study reports on the inheritance of the resistance carried by six varieties of *A. strigosa* ($n = 7$) to races 276, 203 and 216 of crown rust and races 7 and 8 of stem rust as indicated by F_2 populations from intercrosses of resistant by susceptible varieties. Resistance to each of the three races of crown rust was apparently conditioned, in most cases, by a single completely or almost completely dominant gene, or by two independent completely or almost completely dominant genes, either or both resulting in resistance. In some cases, it was questionable whether the resistance was conditioned by a single dominant gene or by a dominant gene and a recessive gene,

either one alone or both resulting in resistance. The results suggested that the diploid varieties may have a dominant gene for resistance to race 203 which also conditions resistance to races 216 and 276. In certain of these the data may be explained by the presence of a second factor for resistance to race 216 or to race 276 linked with and hypostatic to the first. There was no indication of linkage between the genes for crown rust resistance and the single dominant gene conditioning the presence of pubescence on the lower leaf sheath.

The diploid varieties C.I. 4639 (Saia) and C.I. 4746 showed resistance to races 7 and 8 of stem rust but its inheritance could not be determined from the F_2 .

The inheritance of the resistance to crown rust carried by one variety of *A. abyssinica* was also studied. The resistance to races 276 and 203 was apparently conditioned by a single partially dominant gene and resistance to race 216 by a single recessive gene. In the former, the reaction classes were distinct, whereas in the latter they were not.

F_1 hybrid plants were obtained from the crosses *A. abyssinica* ($n = 14$) x *A. strigosa* ($n = 7$), *A. strigosa* ($\bar{n} = 7$) x *A. sativa* ($n = 21$), autotetraploid *A. strigosa* ($n = 14$) x *A. sativa* and *A. abyssinica* x *A. sativa*. Only two out of 16 F_2 , BC_1 and BC_2 individuals resulting from the autotetraploid *A. strigosa* x *A. sativa* cross did not possess the crown rust resistance of the *A. strigosa* parent. No viable self-pollinated or backcross seed was obtained from the other interspecific hybrids.

Cytological studies of all hybrids indicated extreme meiotic instability. Chromosome pairing at metaphase I suggested that the two genomes of *A. abyssinica* are partially homologous with the one from *A. strigosa*. *A. sativa* apparently has one genome in common with the diploid or two or three genomes partially homologous with it. *A. sativa* and *A. abyssinica* may have one genome in common or several that are partially homologous. Bivalents of triploid hybrids showed a general tendency to be of the ring type while those of the tetraploid and pentaploid hybrids were of the rod type. Bivalents of the autotetraploid *A. strigosa* x *A. sativa* hybrid tended to be of the ring type which indicated pairing of *strigosa* chromosomes.

Microfilm \$2.00; Xerox \$5.00. 99 pages.

THE MORPHOLOGY AND PATHOGENICITY OF *LEPTODISCUS TERRESTRIS*

(L. C. Card No. Mic 59-2037)

Donald Vance McVey, Ph.D.
University of Illinois, 1959

Light is required for the formation of both the fruiting structure and spores of *Leptodiscus terrestris* Gerde-mann. The fruiting structure is meristogenous in origin. Branches originate from an initial hourglass shaped cell. Sporogenous cells originate from the apex of each branch, and in turn produce more sporogenous cells which form a saucer shaped fruiting structure. Spores originate from the sporogenous cells. The immature spores are attached to the sporogenous cells by a very short stalk. At maturity the stalk is no longer present. The spores are held together in a head by a mucilaginous substance.

Setae formation begins when the spores reach their mature size. The setae are folded against the spore wall. When the mucilaginous substance is dissolved the setae unfold and expell the spores outward with considerable force.

Spores of *L. terrestris* produce small, sunken necrotic spots of restricted size on leaflets of alfalfa, *Medicago sativa* L.; red clover, *Trifolium pratense* L.; sweet clover, *Melilotus alba* L.; and birdsfoot trefoil, *Lotus corniculatus* L.. On alfalfa and sweet clover the spots are surrounded by a greenish-yellow halo, while on red clover and birdsfoot trefoil the halo is indistinct or absent.

The node of infection was the same on all 4 legumes. Usually only one germ tube arose from a spore. An appressorium formed at the end of the germ tube and was separated from it by a septum. Penetration was direct, intercellular or through a stomata. An infection peg developed from the appressorium. A vesicle formed from the infection peg either between the cuticle and the cell wall or within an epidermal cell. Hyphae grew from the vesicle into the interior of the leaf and remained intercellular.

The fungus produced small, black, elongate lesion on petioles, which caused leaf fall Alfalfa, sweet clover, and birdsfoot trefoil petioles abscised from the stem, while the red clover petioles collapsed at the point of infection.

L. terrestris blackened areas on the stem of the 4 legumes. Infection on young alfalfa and birdsfoot trefoil stems killed the stems from the area of infection to the apex.

The external symptoms of *Leptodiscus* crown and root rot are characterized by dark brown lesions with black bands within the dark brown area of the advancing margin. The internal symptoms on alfalfa are characterized by a "V" shaped black advancing margin of decay. Sclerotia are usually present in the brown decayed tissue.

The fungus entered alfalfa crowns through dead stems and wounds, and the taproot through wounds. The mycelium was intracellular and made its greatest progress longitudinally in the xylem vessels and tracheids in advance of cell disorganization. Periderm formation in the secondary phloem of unwounded roots prevented the fungus from reaching the cambium. Periderm in the xylem did not effectively restrict the advance of the fungus. Vessel plugging occurred in both infected and wounded check roots.

The fungus entered the crown of red clover through dead stems and wounds, and the taproot through wounds and dead lateral roots. The mycelium was intra- and inter-cellular and grew in advance of cell disorganization. A periderm did not always form, and when it was present it did not prevent the progress of the fungus. Vessel plugging occurred in infected roots and in the vessels of wounded check roots.

L. terrestris grew through the secondary phloem and into the xylem of both wounded and unwounded birdsfoot trefoil roots. The mycelium was intracellular and penetrated the cells in advance of cell disorganization. Phellogen formation was not continuous between affected and unaffected cells. Where it did form it was ineffective in preventing the advance of the mycelium.

Microfilm \$2.00; Xerox \$4.40. 81 pages.

THE RELATIONSHIP OF FACTORS AFFECTING APPLE SCALD TO THE FUNDAMENTAL NATURE OF THE DISORDER

(L. C. Card No. Mic 59-1635)

Max E. Patterson, Ph.D.

Purdue University, 1959

Major Professor: Milton Workman

The purpose of this investigation was to determine how certain factors influence scald and submit them to experimental analysis.

The relationship of the following factors to scald were considered important: (1) Oxygen and carbon dioxide concentrations around the fruit. (2) The color of the fruit at the time of storage. (3) The enzymatic system responsible for browning of apple skin.

The influence of controlled oxygen and carbon dioxide concentrations maintained throughout the storage period and in sealed polyethylene crate liners were observed. One per cent oxygen, when carbon dioxide levels were held near that in normal air, delayed scald. Increasing concentrations of carbon dioxide to about 12 per cent, when oxygen concentrations were held near that in normal air, also delayed scald. Carbon dioxide concentrations above 12 per cent resulted in increased scald and in carbon dioxide toxicity, but the scald control achieved was permanent. Low oxygen and increased carbon dioxide concentrations attained in polyethylene liners acted synergistically. The effect of the liner atmosphere in preventing scald increased with the duration of time the fruit were sealed in the liner. Delayed sealing increased scald and caused fruit injury. The oxygen and carbon dioxide environments that reduced metabolic activity delayed the onset of scald.

The relationship of fruit color to scald was investigated by determining the scald on fruit of different degrees of color. Red color was induced in the orchard by reflected light and in cold storage by artificial light. Highly colored fruit when put in storage do not scald. Artificial light will color green fruit in storage if treated before the scald induction period is complete, but will not color similar fruit after the induction period is complete.

A hot water blanching treatment that stopped scald and a temperature coefficient for the scald reaction of 1.8, indicated the enzymatic nature of the reaction. Treatment with reducing agents prevented scald after removal from storage. There was no difference in polyphenoloxidase activity determined manometrically between fruit that would and would not scald. Greater polyphenoloxidase activity was found in the skin of apples that would scald than in the skin of fruit that had scalded. Three prominent substrates of polyphenoloxidase were separated from apple skin extracts by paper chromatography. One substance was chlorogenic acid, the other two were not identified. The same materials were present in strong amounts in fruit that would and would not scald. However, in fruit that had scalded all three substances had nearly disappeared. There was adequate enzyme to catalyze oxidations of these three substrates in the skin of all the scald classes of fruit. Quantities of ascorbic acid in the skin of fruit late in the storage season did not seem to be related to scald.

An explanation for the control of scald achieved with mineral oil was developed which stated that control was due to internal carbon dioxide and oxygen concentrations, not absorption of apple volatiles.

A proposal was made for the scald mechanism. Scald substrates, once available to the fruit, are prevented from browning by the presence of reducing agents, and by a protective effect that accompanies full development of color. Poorly colored fruit will scald after reducing substances disappear. Any treatment which delays disappearance of reducing substances, promotes color or inactivates the browning enzyme will result in control of scald.

Microfilm \$2.00; Xerox \$6.80. 145 pages.

GENOTYPIC CORRELATIONS, DOMINANCE AND HERITABILITY OF QUANTITATIVE CHARACTERS OF OATS

(L. C. Card No. Mic 59-2421)

Frank Charles Petr, Ph.D.
Iowa State College, 1959

Supervisor: K. J. Frey

Three methods of estimating the degree of dominance of six quantitative characters of oats were applied to F₁ data obtained from the 15 diallel crosses of the six varieties -- Palestine, Andrew, Cody, Markton, Roxton, and Victory. Two of the methods, constant parent regression and the potence ratio, provided estimates of the direction of dominance and the components of variance method gave an estimate of the degree only. Genotypic and environmental correlations between the six attributes, namely height, panicle length, heading date, number of spikelets per panicle and grain yield, were calculated from F₁ data. Variances and covariances of the crosses in the F₂ generation provided a basis for estimating heritability in the broad sense as well as genotypic and phenotypic correlations between all combinations of the six characters.

Positive partial dominance values were obtained for height by all three methods. Partial dominance was indicated for panicle length but the direction of dominance was not consistent. Heading date showed partial negative dominance with good agreement among the three methods. Partial negative dominance was found for spikelets per panicle by the constant parent method while the potence method indicated partial positive dominance. Overdominance was found by all three methods for a high number of panicles per plant. Partial, complete and overdominance were found for yield by the components of variance, constant parent regression and potence ratio methods, respectively.

Heritability values for all crosses averaged 33, 53, 54, 61, 74 and 87 percent for panicles per plant, grain yield, panicle length, plant height, number of spikelets per panicle and heading date, respectively. The genotypic correlations for panicle length with height and number of spikelets per panicle were high whereas low genotypic and high environmental correlations were found between yield and panicle production indicating that progress from selection for these traits would be slow. The negative genotypic correlation between the yield components, panicles per plant

and spikelets per panicle, suggest that the optimum combination of these traits may not reflect the maximum potential of either one. Relatively high phenotypic correlations were obtained for height with panicle length, spikelets per panicle and grain yield. Phenotypic and genotypic correlations were generally of the same magnitude but the latter were more erratic in certain crosses.

The high dominance variances observed for yield and panicle production coupled with low heritability values indicate that selection for these attributes should be delayed until later generations while selection for height, panicle length, heading date and number of spikelets per panicle would be feasible in early generations.

Microfilm \$2.00; Xerox \$3.00. 55 pages.

A STUDY OF FACTORS INFLUENCING PITHINESS IN THE RADISH (RAPHANUS SATIVUS L.)

(L. C. Card No. Mic 59-2367)

Hyun Koo Pyo, Ph.D.
University of Minnesota, 1959

The enlarged root-hypocotyledonary axis, so-called edible "root", of the radish (Raphanus sativus L.) is said to be "pithy" when cottony-white masses of dead cells appear in the xylem parenchyma tissue. Spring-type radishes begin to get pithy shortly after roots start to enlarge rapidly in the field. Foliar applications of sucrose and partial defoliation (removal of as much as 80 per cent of the total leaf weight) when radishes were enlarging rapidly had no effect on incidence of pithiness. Shading of plants to reduce light intensity decreased root size and decreased the severity of pithiness proportionally. Therefore, under field conditions, pithiness does not appear to be related to insufficient carbohydrate production but may be the result of intercellular competition for nutrients in the root. Radishes subjected to severe defoliation (more than 80 per cent), soil moisture stress, or high temperature storage developed an abnormal type of pithiness which probably resulted from carbohydrate depletion. Foliar applications of maleic hydrazide within seven days before harvest did not check plant growth in the field but inhibited regrowth of shoots and roots and retarded pithiness development to some extent during storage.

Microfilm \$2.00; Xerox \$3.00. 60 pages.

BASIS FOR RESISTANCE OF ASPARAGUS OFFICINALIS VAR. ALTILIS L. TO THE STUBBY-ROOT NEMATODE TRICHODORUS CHRISTIEI ALLEN 1957

(L. C. Card No. Mic 59-1923)

Richard Allen Rohde, Ph.D.
University of Maryland, 1958

Supervisor: Dr. William R. Jenkins

Populations of Trichodorus christiei Allen 1957 would not reproduce on roots of Asparagus officinalis var. altilis

L. variety Mary Washington. Decline of populations on young plants was at the same rate as decline of populations in soil with no plant roots present. After storage root formation, asparagus plants caused a reduction in populations of *T. christiei* more rapidly than could be accounted for by starvation. Tomato, normally an excellent host, supported only very low nematode populations when asparagus was growing in the same pot.

Feeding could not be observed on asparagus roots after plants had passed the young seedling stage and nematodes recovered from older asparagus plants lacked intestinal contents, an indication that they were not feeding. *T. christiei* specimens readily ingested radiophosphorus or rhodamine B from labeled tomato plants, but did not ingest these compounds from similarly labeled asparagus plants.

Juice from asparagus roots was toxic to individuals of *T. christiei* even when diluted 1:10 with water while tomato root juice was not toxic. Juice from storage roots of asparagus was much more toxic than that from fibrous roots.

A toxic compound was isolated from asparagus roots by the following procedure. Freshly expressed juice was autoclaved and evaporated to a small volume in a stream of warm air. Ethanol was added until a 70 per cent solution was obtained and the precipitate was removed by centrifugation. The ethanolic extract was dried in vacuo and the residue was washed repeatedly with n-butanol. The n-butanol extract was dried in vacuo and the residue redissolved in water. The aqueous solution was poured through an Amberlite IRC-50(H) cation exchange resin column. The toxic entity was adsorbed on the resin and could be recovered by elution with 95 per cent ethanol. The eluate was streaked across sheets of Whatman No. 1 filter paper and chromatographed by the descending technique using n-butanol, ethanol, and water (10:1:2 by volume) as a solvent. Biological assay revealed the presence of the toxic compound as a distinct band which was cut from the paper. The toxic material was recovered from the paper by elution with water.

The final product had the chemical properties of a carbohydrate and this identification was confirmed by ultraviolet and infrared absorption spectra. The compound was composed of 50.70 per cent carbon, 6.84 per cent hydrogen, and 42.46 per cent oxygen and had a molecular weight between 140 and 157. Reducing power was not evident until after acid hydrolysis, indicating the release of a reducing sugar. It was concluded that the compound was a glycoside with a low molecular weight aglycone.

The compound was also obtained from soil surrounding asparagus roots by leaching with water and following the extraction procedure outlined above.

Non-reversible paralysis of specimens of *T. christiei*, *Paratylenchus projectus* Jenkins 1956, *Tylenchorhynchus claytoni* Steiner 1937, *Belonolaimus gracilis* Steiner 1949, *Tylencholaimellus striatus* Thorne 1939, *Pratylenchus* sp., and *Diphtherophora* sp. occurred within 18 hours in 0.01 per cent solutions of the toxic compound. No antifungal or antibacterial activity was found.

Populations of *T. christiei* around tomato roots were reduced by either spraying the leaves or drenching the root zone with 0.1 per cent solution of the toxic compound.

Microfilm \$2.00; Xerox \$3.00. 47 pages.

A STUDY OF THE NECROSIS SOMETIMES ASSOCIATED WITH INFECTION OF CEREAL PLANTS BY *PUCCINIA GRAMINIS* PERS.

(L. C. Card No. Mic 59-2378)

William Silverman, Ph.D.
University of Minnesota, 1958

Adviser: Helen Hart

Marquis wheat infected with race 38 of *Puccinia graminis tritici* is resistant at low temperatures (65-75°F.) as indicated by uredia of an infection type 2, and susceptible at high temperatures (85-95°F.) with uredia of an infection type 3. The host cells during the early stages of necrotic ring development in the infection type 2 lesion are characterized by aberrant chloroplasts which have an abnormal affinity for safranin; in the later stages of necrotic ring development, the cytoplasmic structures, including the aberrant chloroplasts, disappear and the host cell walls thicken and stain abnormally with safranin. Infected Marquis plants grown at high temperatures produce a toxin which can be extracted with a phosphate buffer solution; when chromatographed on Whatman #1 paper with butanol as a developing solvent the toxin moves only a short distance from the origin. The toxin is a water soluble, heat stable substance capable of being stored at -10°C. for at least 4 months. When infiltrated under a partial vacuum into Marquis seedlings grown at low temperatures, the toxin produces chlorotic areas; no chlorosis is produced on Marquis grown at high temperatures. On Little Club wheat, which is susceptible to race 38 at all temperatures, chlorosis does not develop after infiltration with the toxin at any temperature tested. The cells of the chlorotic areas have the aberrant chloroplasts characteristic of infection type 2; however, the swollen cell walls are not present. Swollen, abnormally staining cell walls develop when Marquis leaves are infiltrated with a pectinase solution. It is suggested that the toxin isolated from infected Marquis wheat and the enzyme pectinase are responsible for that part of the syndrome of infection type 2 known as the necrotic ring.

Microfilm \$2.00; Xerox \$4.20. 79 pages.

A STUDY OF THE PROPERTIES AND MODE OF ACTION OF NYSTATIN IN RELATION TO PLANT DISEASE CONTROL, AND OF THE CHEMICAL ASSAY OF STREPTOMYCIN IN PLANT TISSUE

(L. C. Card No. Mic 59-1832)

Norman Wilson Tape, Ph.D.
Rutgers University, 1959

Major Professor: Dr. B. H. Davis

Nystatin is a relatively broad-spectrum, antifungal antibiotic belonging to the polyene group of antibiotics. It is widely used in the therapy of fungous diseases of man, and has shown activity against plant pathogenic fungi. The growth of sensitive fungi is inhibited by concentrations ranging from 2 to 60 units per ml., whereas no activity is

expressed against bacteria, actinomycetes, rickettsiae, or animal cells.

Nystatin was inactivated in solutions of macerated tomato, tobacco, and geranium leaves. The amount of deactivation depended on the species of plant; only a small percentage of the nystatin remained active, in any of the leaf solutions, following 48 hours incubation at room temperature. Nystatin inactivation in the leaf solutions does not necessarily mean that it would be inactivated to the same extent within the intact leaf.

Almost all of the activity of nystatin was lost in soil. The nystatin was strongly bound to the clay minerals in soil, forming an inactive complex. Adsorption was not greatly affected by the soil reaction.

Nystatin was not toxic to tomato, bean and gladiolus plants, even at a concentration of 6000 units/ml. Phytotoxic symptoms observed in the experiments were caused by the solvent used to dissolve nystatin. The 2 per cent calcium chloride in methanol was the best solvent, since it was only slightly phytotoxic at very high concentrations.

Absorption of nystatin through the epidermis of blueberry fruit was not detected, whereas absorption did occur into peach fruit and Sedum leaves. In order to detect absorption in the latter two cases, a very high concentration of nystatin, in solution with a wetting agent, was required.

Nystatin did not protect cucumber and pea seeds from pre-emergence damping-off.

Two dust treatments, pure talc and 17 units of nystatin/mg. talc, when applied to the base of geranium cuttings, stimulated rooting the greatest amount above that of the controls. The amount of stimulation was not considered sufficient to warrant the use of these treatments commercially.

The incidence of blackleg disease of geraniums was reduced significantly, in soil heavily infested with *Pythium* sp., by dusting the bases of the cuttings with dust containing 8.5 units of nystatin per mg. of talc.

Rooting of tomato cuttings was not stimulated by standing their bases in nystatin solutions for one hour prior to planting in sand.

Low levels of nystatin were toxic to the spore germination of *M. fructicola*, *Botrytis* sp., *Rhizopus* sp., and *Diplodia tubericola*. The action of nystatin was fungicidal to spore germination of *M. fructicola*, and *Botrytis* sp., whereas it was fungistatic to *Rhizopus* sp. The rate of uptake of nystatin by spores of the latter three species was slow compared to other fungicides. Approximately 66 per cent of the nystatin was removed in three hours. The amount received by the spores, on a spore weight basis, was 320 to 430 fold the concentration of the external solution. Nystatin toxicity to spore germination of *M. fructicola* compares favorably with that of silver.

The site of action of nystatin in the test species of filamentous fungi appears to be located in the aerobic portion of glucose catabolism, perhaps an enzyme in the Krebs cycle. Fungous spore respiration was not as sensitive to nystatin as was spore germination.

Cysteine probably prevents the inhibition of action of nystatin on yeast growth by forming an inactive complex with nystatin. No explanation can be given as yet for the fact that cysteine did not prevent nystatin's inhibition of *S. cerevisiae* metabolism.

The chloroform extraction and maltol distillation methods for the chemical assay of streptomycin proved to be unsatisfactory for quantitative determination of small amounts of streptomycin in plant tissue.

Microfilm \$2.00; Xerox \$5.00. 100 pages.

ANTHROPOLOGY

EXPLORATIONS IN THE CROSS-CULTURAL STUDY OF MENTAL DISORDERS

(L. C. Card No. Mic 59-2468)

Donald Alexander Kennedy, Ph.D.
Cornell University, 1959

In this study, the problems connected with initiating a cross-cultural study of mental disorders are considered, and the results of two brief pilot studies among the Navaho Indians of the American Southwest are reported.

Within recent years a number of research projects have studied various aspects of the problem of mental illness in its community and societal setting. These investigations have included epidemiological efforts to locate actual prevalence rates for community and county populations, as well as relational studies which have attempted to link differential rates and patterns of illness with sociocultural factors of possible etiological significance. To date, these research efforts in the field of social psychiatry have not included an epidemiological study in a non-literate society, nor a comparison of rates and patterns

of disorders to be found in such a society with those known to exist in selected communities of the United States and Canada.

In the search for key elements of, what might be termed, "noxious" and "benign" sociocultural environments associated with differential rates of illness, it seems appropriate to extend these studies into the cross-cultural area. In light of the difficulties to be expected in trying to locate psychiatric cases in a culture radically different from our own, it is necessary to explore the major dimensions of this problem area in detail before starting a large-scale program of research in the field. This thesis describes a research effort that was directed to such a preliminary analysis of the problematic situation. It reports a scouting expedition, the purpose of which was to discover the central conceptual and methodological issues that face research workers in this new and challenging area.

The thesis is divided into three major divisions. The first part deals with the general context of research interest in the problem of mental illness, as seen from the vantage points of social psychiatry and cultural

anthropology. The second part reports on two pilot studies conducted among the Navaho in order to test out specific research questions and strategy under field conditions. These field studies were of extremely short duration and were focussed upon problems of method and approach rather than upon the task of contributing significantly to the ethnographic literature.

The first of these studies investigated the reactions of doctors trained in Western medicine to difficulties encountered in diagnostic procedures with Navaho patients. It was found that the language barrier presented a major challenge to the doctor and caused him to modify his standard diagnostic technique in a way that suggests complications for the conduct of psychiatric evaluations with members of the general population. The second study was aimed at providing a sketch of Navaho beliefs about illness in general and mental illness in particular. A brief sketch of indigenous beliefs indicated that they were markedly different from those of the doctor and that they presented a major element of difficulty in the medical interview. In addition, the supernatural emphasis of native beliefs about the causes of illness will make the comparison of native and psychiatric viewpoints on the topic of mental disorders very difficult indeed.

The last part of the thesis presents a set of specific substantive problems for future investigation, some recommendations about method and approach in the field, and a discussion of certain theoretical schemes available for the guidance of empirical research. A major finding of this analysis was that a range of behavior including deviant actions and healthy patterns of personality should be included in the study, along with the patterns usually referred to as "psychiatric symptoms."

Microfilm \$4.00; Xerox \$13.40. 308 pages.

A RACIAL STUDY OF THE WEST NAKANAI OF NEW BRITAIN

(L. C. Card No. Mic 59-2278)

Daris Ray Swindler, Ph.D.
University of Pennsylvania, 1959

Supervisor: Wilton Marion Krogman

The central problem throughout this study was the racial position of the West Nakanai. How do these people fit into the racial scheme of Melanesia? Are they truly a part of the Melanesian racial pattern or do they represent a foreign element that has fortuitously settled within the geographical parameters of Melanesia? Another aim of the present investigation was to present a detailed description of the West Nakanai phenotype against a background of his contemporaries. A discussion of the serological picture was presented as well as, comment concerning the absence of the sickle cell gene in Melanesia. The physical variability of a population is an important aspect of all racial investigations. In the present study, this problem was approached from the standpoint of the degree of morphological differentiation obtaining within and between the West Nakanai villages.

Detailed anthropometric measurements were procured on 269 males from 15 West Nakanai villages. Means,

standard deviations, and coefficients of variation were presented. Blood samples were collected by the finger prick method and the samples were analyzed by R. T. Simmons and his colleagues in Melbourne, Australia. In order to gain further information concerning the physical affinities of the West Nakanai, they were compared with 14 other groups from separated areas within Melanesia. The biological distance between these 14 populations was estimated by means of the discriminate function of L. S. Penrose. West Nakanai variability was estimated by the analysis of variance.

The West Nakanai were placed in time and space. In general, the population approached panmixia and it can be said to constitute an intrabreeding population. The West Nakanai were shown to fall well within the ranges expected for Melanesia in both anthropometric and serologic characters. The analysis of variance indicated that different culturally determined breeding habits had different but important effects on variation in physique and that tendencies toward local variations in measurements were different in the groups investigated. The coefficient of distance analysis supported the Melanesian racial status of the West Nakanai, and further, indicated certain patterns of relationships among the various groups in the study.

Microfilm \$2.40; Xerox \$8.40. 183 pages.

AN INTRODUCTION TO THE HISTORY OF CHANGING WAYS OF LIFE ON THE ISLAND OF NEW BRITAIN

(L. C. Card No. Mic 58-3378)

Charles A. Valentine III, Ph.D.
University of Pennsylvania, 1958

Supervisor: W. H. Goodenough

This study traces the social history of the polyglot populace of Melanesians, Europeans, Asians, mixed-bloods and others inhabiting New Britain. The period covered by this history extends from the sixteenth-century beginnings of European exploration in Melanesia to the present. The dissertation presents a delineation of the origins, an examination of the multiple paths of development, and an analysis of the contemporary nature of New Britain's multiracial society.

The study had its inception in two periods, together amounting to nearly a year and a half, of historically oriented anthropological field research focused on problems of culture contact and acculturation in New Britain. Approximately two years were devoted to documentary historical and comparative research in Australia and the United States, including examination of primary and secondary sources on exploration, official reports and other documents of the various relevant governments and international organizations, military sources of several armies, missionary publications and documents, newspaper and other nonofficial periodical files, and a wide variety of anthropological, historical and other studies. Techniques of sociological analysis, including elementary statistical procedures, were applied to quantitative data from European, Asian and indigenous Melanesian groups on the island. The methodological aim of the project was to

integrate these varied approaches to diverse sources of data into an ethnohistorical technique for the study of social change and acculturation in the formation of ethnically diverse social systems.

The preliminary portions of the dissertation are devoted to exploring methodological and theoretical issues pertinent to such an approach, with particular reference to conditions, common to Melanesia and a number of other areas, in which millenarian religious movements develop. One introductory section constitutes a critical survey of relevant theoretical formulations in the anthropological literature. Another sketches the crosscultural context of millenarian cults. The main body of the dissertation begins with a geographic description of New Britain and an ethnographic survey of its indigenous peoples and their traditional cultures. In the bulk of this section the history of the island before 1942 is recounted. The second major division of the study is devoted to a sociological analysis of the multiracial society which had developed its characteristic structure before the Second World War. The final section describes the new elements injected into island life by the war, delineates the process of postwar recovery, and brings the sociocultural analysis of the plural society

up to date. The dissertation concludes with a consideration of major contemporary economic, social and political problems.

An important source of continuity in New Britain history is the development and perpetuation of a social system founded on stratification of ethnic groups. Closely congruent with this system is the espousal by dominant power groups of a policy of dual development, resting on the assertion that both native Melanesian and alien European or Asian interests can be progressively advanced without major social conflict. Over a lengthy period, these and other factors have tended to block indigenous development and to foster the growth of cargo cults, which are the typical Melanesian form of millenarian politico-religious movements. It has become apparent in recent years that the dual policy is no longer valid even in terms of alien development alone. Whether the developmental goals of modernization now common, in one form or another, to practically all peoples in New Britain can be achieved peacefully will depend, in large part, on the potentiality for active innovation in the system of social stratification and operative revision of the traditional philosophy of dual development. Microfilm \$10.56; Xerox \$37.70. 836 pages.

BACTERIOLOGY

THE GENETIC PROPERTIES OF THE
TRANSDUCING PARTICLES OF
BACTERIOPHAGE P1

(L. C. Card No. Mic 59-1996)

Mary Jane Neal Adams, Ph.D.
University of Illinois, 1959

In the process of transduction, bacteriophages serve as vectors in the transfer of single or closely-linked genetic characters from one bacterial strain to another. Cell-free phage lysates prepared by the growth of the phage on donor bacteria of known genotype contain a small proportion (10^{-5} to 10^{-8}) of particles that are capable of transferring genetic markers of the donor to recipient bacteria of a different genotype. This paper reports a study of these "transducing particles" with regard to their genetic composition and to the relationship between their phage and bacterial components after entry into the recipient cells.

P1, a temperate phage which will transduce *Escherichia coli* K strains and *Shigella dysenteriae* Sh strains, was used. The genetic properties of normal P1 phage particles were studied by observing the characteristics of cells which survive P1 infection. All or nearly all of the progeny of these cells were found to be lysogenic, i.e. they carry the P1 genome as a part of their genetic apparatus. The presence of this phage genome, or prophage, confers to the cells the ability to produce infectious phage particles and an immunity to P1 and related phages. Techniques were designed to test for the presence of these phage-controlled properties in clones from transduced cells to determine if these cells receive a normal P1

genome from the transducing particle, as well as new bacterial genetic material.

Most host genetic markers transferred from K donors via phage P1 lysates are readily integrated into K or Sh recipients. This includes K cells transduced to contain the characters (TL)⁺, Lac⁺, Xyl⁺, and S^r, and Sh cells transduced for Ara⁺ and S^r. Clones of transduced bacteria from singly-infected cells are generally nonlysogenic and sensitive to P1. This suggests that the phage genome in transducing particles is either absent, or abnormal, or excluded in the recipient cells.

Abnormal phage genomes are detected in Sh recipient cells transduced for the Lac⁺ marker by P1 grown on either K or Sh donors. This marker is rarely integrated into Sh cells, but persists in association with the abnormal phage genome as an exogenetic fragment. The phage genome confers immunity to P1 and is defective, that is unable to produce mature phage particles.

High frequency transducing lysates for Lac⁺ can be produced by UV irradiation and superinfection of some strains carrying the Lac - P1 def exogenote. The defective particles in these lysates require help from normal phage to transfer a functional Lac⁺ marker. In Sh cells transduced by these lysates Lac⁺ remains associated with the defective P1 genome. In K recipients, however, no recognizable phage genome is found following transduction by single-infection with particles from either high or low frequency lysates. The Lac⁺ marker is integrated without the establishment of the associated defective phage genome. Thus, the absence of phage-controlled properties in clones from cells transduced for host characters other than Lac cannot be considered as evidence that transducing particles contain no phage genome.

The association between a host marker and a defective phage genome in the P1-Lac transductions may be compared with a similar situation in the λ -Gal specialized transductions. The coliphage λ can transduce only those host markers that are closely linked to the λ prophage site. As P1 lysates will transduce a large number of host characters from different loci, the above data suggests transducing particles may arise from recombinational events between phage and bacterial genomes at loci other than those near the specific site of the prophage.

Microfilm \$2.00; Xerox \$6.00. 125 pages.

THE SURVIVAL AND MUTABILITY OF ESCHERICHIA COLI IN AQUEOUS SOLUTIONS OF OZONE

(L. C. Card No. Mic 59-2228)

Irving Davis, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Joseph S. Gots

This report describes a series of studies designed to provide an understanding of the biological activity of ozone at the cellular level. A critical analysis of the quantitative lethality and mutagenesis of ozone was undertaken.

Ozone was produced by a Welsbach water-cooled corona discharge ozonator using dry, clean oxygen. Analyses for ozone in aqueous solutions were carried out spectrophotometrically. Cells of *E. coli* were exposed to aliquots of ozonated-water stock solutions. Bacterial survivors and mutants were determined by recognized plating procedures.

Maximum lethal effects of ozone over a wide concentration range (0.1 to 1.5 mcg. per ml.) were expressed in one minute or less on the bacterial population (approx. 2×10^8 cells per ml.). Lethality in this range of ozone was from 63 to 99.5 percent. The number of cells surviving exposure is a function of approximately the cube of the initial cell concentration. This holds true over a wide range of ozone values (0.1 to 1.74 mcg. per ml.). A plot of data for percent survival as a function of ozone concentrations showed extreme variations. A probit analysis was completed based on the assumption that tolerance to log concentration of ozone is normally distributed in the population. Percent kill increased sharply over a narrow range of ozone concentrations (0 to 0.4 mcg. per ml.) and then leveled off. The ozone tolerance of strains B and B/r of *E. coli* appear to be similar, if not identical.

The mutagenesis of ozone in aqueous solutions on *E. coli* was studied in two mutational systems. Mutation frequencies in the streptomycin-dependence method appear to increase with increasing concentrations of ozone and decreasing survival. In the phage-resistance method, the frequency of zero point mutants showed a significant increase after ozone exposure of the cells. Attempts to isolate ozone-resistant mutants have been without success.

The growth characteristics of cells surviving the lethal effects of ozone were studied. There was no observable difference between the cells exposed to ozone when compared to the control cells.

The role of hydrogen peroxide in ozone lethality and mutagenesis was studied. Experiments were designed to

test for the possible formation of hydrogen peroxide in aqueous solutions of ozone. Several lines of evidence suggest that when ozone is absorbed in aqueous solutions, oxidants are formed which do not seem to be identifiable as hydrogen peroxide. Certain characteristics of these oxidants have been determined.

The importance of free radicals in biological processes is discussed. Evidence in the literature on the formation of these radicals during the absorption of ozone in aqueous solution is reviewed. It is suggested that a common pathway exists in the formation of these active radicals following irradiation, ozonization, or oxygen poisoning of biological specimens.

Microfilm \$2.00; Xerox \$5.20. 104 pages.

BIOCHEMICAL AND SEROLOGICAL SEPARATION OF SOME MEMBERS OF THE GENUS *VIBRIO*

(L. C. Card No. Mic 59-2525)

Leo Ralph DiLiello, Ph.D.
University of Maryland, 1958

Supervisor: Dr. John E. Faber, Jr.

Routine biochemical tests were employed to characterize 68 different vibrio cultures from animal and human sources. In addition an attempt was made to further characterize all cultures by serological means. Catalase, H_2S production, reduction of nitrate, salt-tolerance, changes in litmus milk and final pH of 5 day thioglycollate cultures were more suitable than indole production, urease activity, gelatinase activity, growth in nutrient broth, methylene-blue sensitivity and the cholera-red reaction for differentiating these vibrios.

Cultures were of bovine, ovine, human, porcine and avian origin. Cultures included bovine, ovine and human strains of *Vibrio fetus* of fetal and non-fetal origin, bovine, ovine and human catalase-negative vibrios of non-fetal origin, cultures of the "related-vibrio" group isolated from human cases of gastroenteritis, vibrios isolated from cases of swine dysentery, *V. jejuni*, *V. comma*, *V. metschnikovii* (avian origin) and 4 saprophytic species.

Inocula used for biochemical tests and antigen production were stabilized by growing cultures on Albimi Brucella agar in an attempt to use smooth cultures throughout the study. The method was found satisfactory for the production of smooth stable antigens.

Rabbits were selected for the preparation of antisera. In all cases, high homologous titers were obtained. The serological test employed was the reciprocal cross-agglutination test.

All *V. fetus* strains (groups I, III and IV) regardless of source of isolation appeared to be serologically related and biochemically similar. Bovine strains were characterized as catalase-positive, usually H_2S -negative, salt-sensitive and unable to grow in plain litmus milk. Ovine and human strains differed in 2 respects from bovine strains. They consistently produced traces of H_2S and frequently peptonized enriched litmus milk. One human isolate which appeared to be *V. fetus* serologically proved to be catalase-negative and salt-tolerant.

Members of the "related-vibrio" group (group V) which

appeared to be serologically related to *V. fetus* could be distinguished biochemically from *V. fetus* by the H_2S reaction and their behavior in enriched litmus milk.

Members of the catalase-negative group of bovine and ovine origin (group II) were related to each other and as a group were serologically distinct. These vibrios were characterized as catalase-negative, H_2S -positive, salt-tolerant, little or no change of pH in 5 day thioglycollate cultures.

The group of swine vibrios (group VII) was found to be serologically heterogeneous. The presence of 3 subgroups based on serological reactions was suggested.

The possibility of swine harboring *V. fetus* is likely. Vibrios were detected in swine which appeared to be *V. fetus* serologically and biochemically except for their ability to tolerate 3 per cent salt. It is possible that cross-infection with vibrio exists between swine and other livestock.

Swine vibrios which showed no serological relationships with *V. fetus* were characterized biochemically as catalase-positive, H_2S -positive, salt-sensitive and capable of producing changes in plain litmus milk.

Electron micrographs produced of swine cultures revealed that they are properly placed in the genus *Vibrio*.

All *V. fetus* strains, members of the "related-vibrio" group, catalase-negative vibrios and swine dysentery vibrios were unable to ferment any of the carbohydrates tested.

V. comma, *V. metschnikovii* and 4 saprophytic species were serologically distinct. These vibrios possessed clear-cut differential biochemical characters which rendered them to be easily separated and differentiated from *V. fetus* and other closely related vibrios.

The source of isolation, the use of prepared antisera for serological identification and the performance of several biochemical tests on pure cultures should be considered in order to insure accurate identification of vibrio cultures. Microfilm \$2.00; Xerox \$5.20. 105 pages.

THE GROWTH AND AUTOTROPHIC METABOLISM OF *NITROSOMONAS EUROPAEA*

(L. C. Card No. Mic 59-1952)

Manfred Sidney Engel, Ph.D.
Cornell University, 1959

The recent revival of interest in the autotrophic nitrifying organisms has focused attention on the problems associated with their growth in solution culture. Studies of the nutrition and biochemistry of *Nitrosomonas europaea*, in particular, have been complicated by the use of culture media containing large quantities of insoluble constituents, especially calcium carbonate. It had been proposed that adsorption to particles was a growth requirement.

In the present study, cultural conditions have been devised which permit rapid growth of *N. europaea*. No requirement was found for sodium chloride or micronutrient elements, nor was adsorption to solid surfaces a prerequisite for growth.

A 25 L fermentor was used for growing large quantities of cells and cell suspensions were prepared free of insoluble

chemical precipitates. The organism grows with an eleven hour generation time and a sixty hour logarithmic phase, producing a final concentration of 0.083 M nitrous acid in the medium. In this experiment the yield of cells was 72.4 mg (dry weight) per liter.

The rate of cell synthesis was proportional to the amount of substrate metabolized, indicating a constant free energy efficiency during a long growth period. The ratio of ammonium oxidized to carbon dioxide fixed was about 30:1, corresponding to a free energy efficiency of 8.2 percent.

Cell suspensions of *N. europaea* were used to study the rate of the autotrophic oxidation of ammonium and hydroxylamine. The oxidation of both proceeds at a rapid rate and the oxygen consumed approaches the theoretical for the nitrification reaction. There is no sharp pH optimum for ammonium oxidation from about pH 6.8-9.0. Hydroxylamine has a somewhat narrower optimum range, pH 7.5-9.0 and measurement of this optimum was complicated by a buffer effect. The optimum ammonium level was dependent upon the pH and the possible toxicity of the undissociated ammonia form was discussed.

The effect of various inhibitors on respiration was measured. Hydroxylamine was found to act both as substrate and an inhibitor for freshly harvested cells, but on storage this inhibitor effect was diminished. Preliminary evidence was presented that may implicate hyponitrite as the intermediate at the +1 state of nitrogen.

Cell extracts incubated with hydroxylamine as substrate reduced methylene blue and 2,4,5-triphenyl tetrazolium chloride and caused the disappearance of substrate. The methylene blue activity was recovered entirely in the soluble portion of the extract after removal of all particulate components by centrifugation at 144,000 X G. Extracts were found to have a strong catalase and a measurement of the cytochrome spectrum revealed a Soret band and peaks at 524, 553, and 602 m μ .

Microfilm \$2.00; Xerox \$5.20. 104 pages.

A STUDY OF THE BIOSYNTHETIC CAPABILITIES OF ISOLATED BACTERIAL NUCLEAR BODIES

(L. C. Card No. Mic 59-2017)

David Hirsch Ezekiel, Ph.D.
University of Illinois, 1959

Nuclear bodies of *Bacillus megaterium*, isolated from protoplasts by digestion of the cell membranes with pancreatic lipase, were tested under a variety of conditions for the ability to synthesize nucleic acid and protein. No increase in deoxyribonucleic acid (DNA), ribonucleic acid (RNA), or protein, and no incorporation of labelled amino acids, uridine, or thymidine could be detected, even in the presence of whole lysates.

Increase in the acid-precipitable ultraviolet-absorbing material during incubation with adenosine triphosphate (ATP) or adenosine diphosphate (ADP) was attributed to the presence of a polynucleotide phosphorylase. The activity was not enriched in nuclear preparations; on the other hand, the activity in nuclear preparations could not be abolished by washing, so that apparently some of the enzyme is fixed to the nuclear bodies. With the crude

enzyme, measurable polymerization was obtained with ATP, ADP, and perhaps uridine diphosphate, but not with guanosine and cytidine diphosphates, or mixtures of the four diphosphates, and no depolymerization of endogenous RNA could be detected. The reaction was magnesium-dependent, and was inhibited by inorganic phosphate.

Initial studies of the relation of the nuclear bodies to the Kornberg DNA-synthesizing system were carried out. No formation of triphosphates from pyrophosphate and endogenous DNA could be detected. Direct phosphorylation of thymidine with ATP could not be demonstrated, although intact cells incorporated thymidine into their DNA.

It seems probable that the nuclear bodies do not represent a complete system for synthesis of the principal macromolecules. In the light of the physical exposure of the DNA in such preparations, it is suggested that the immediate function of the DNA in biosynthesis might require interaction with enzymes of the cytoplasm.

Ferric ion binding of DNA was demonstrated. Conventional acid hydrolysis extracted the purines from such bound DNA, but failed to extract the remaining components, which could be demonstrated in the insoluble material. One gram atom of ferric ion binds some 1000 to 1600 grams of DNA. It is suggested that the binding not only aggregates the DNA but also inhibits hydrolysis of the sugar-phosphate bonds.

A base ratio determination for the *B. megaterium* DNA supports published figures.

Possible interconversions of nuclear and cytoplasmic RNA were studied by means of kinetic examination of *in vivo* incorporation of uridine and phosphate. In the course of these studies, a new fraction was obtained from the supernatants of nuclear preparations. This material, precipitated or aggregated by the addition of 10% polyethylene glycol to the supernatant after centrifugation of lipase digests, contained up to half of the RNA and protein of the cell, and most of the DNA which failed to sediment with the nuclear bodies.

The RNA appearing in this fraction appeared to be less active in phosphate incorporation than the remaining RNA of the cell. The remaining cytoplasmic RNA could not be convincingly distinguished from the nuclear RNA by rate of labelling. Comparison of the specific activity of cellular and nuclear RNA during uridine incorporation and subsequent growth failed to support the hypothesis of the nuclear origin of cytoplasmic RNA.

Microfilm \$2.00; Xerox \$5.80. 118 pages.

**LACTOBACILLUS BIFIDUS VAR. UREOLYTICUS;
AN OBLIGATELY ANAEROBIC
UREA-HYDROLYZING BACTERIUM**

(L. C. Card No. Mic 59-2528)

Ronald John Gibbons, Ph.D.
University of Maryland, 1958

Supervisor: Dr. Raymond N. Doetsch

The purpose of this investigation was to attempt to isolate obligately anaerobic, urea-hydrolyzing bacteria from the rumen, for few organisms with these characteristics have been described. Preliminary studies indicated

that the bacteria were mainly responsible for the urease content of rumen fluid; the anaerobic varieties apparently being the major contributors. It was further ascertained that large quantities of nitrogenous substances inhibited urease production in growing mixed cultures of rumen bacteria.

On the basis of this information, an obligately anaerobic, urea-hydrolyzing bacterium was isolated in pure culture. The morphological and physiological properties of the organism suggested it was related to *Lactobacillus bifidus*, and consequently the name *L. bifidus* var. *ureolyticus* was proposed. Nutritional requirements of the organism have been determined, and long forms observed to develop from certain vitamin deficiencies.

Some factors governing urease production by this bacterium were also investigated. It was found that the formation of urease was impaired when the organism was grown in media containing large concentrations of certain organic nitrogenous substances. Urea, $(\text{NH}_4)_2\text{SO}_4$, and manganese also reduced enzyme synthesis, although iron overcame the inhibitory properties of the latter.

Because of the relatively low numbers of this organism in the rumen (approximately 10^5 per g), it is difficult to ascertain if it is mainly responsible for the urease activity possessed by the rumen microflora. However, estimates of the total number of urea utilizing bacteria present in sheep on normal and urea diets were found to be in the same magnitude. Microfilm \$2.00; Xerox \$4.80. 92 pages.

**A COMPARATIVE STUDY OF THE BACTERIAL
FLORA OF CARIES-SUSCEPTIBLE AND
CARIES-RESISTANT INDIVIDUALS**

(L. C. Card No. Mic 59-2285)

Gordon Edmund Green, Ph.D.
The Ohio State University, 1953

Present concepts of tooth decay in humans are based upon Miller's observations that oral bacteria could produce acid from ordinary foodstuffs,¹ and upon the work of Williams, who found that bacteria exist in tenacious films on tooth surfaces.² The acidogenic theory of Miller, modified by later investigators, states that carious lesions are initiated and developed by bacterial activity. Organisms existing in masses adherent to tooth surfaces in what are called plaques, produce acid by enzymatic activity from fermentable food materials taken into the oral cavity. The acid produced as a by-product in close conjunction to tooth surfaces, somewhat protected from the diluting effect of saliva by the consistency of the plaque, results in decalcification of enamel, which is the first stage of a carious lesion. Further development of the lesion is the result of additional acid formation at that site. Tooth decay is a disease caused by bacterial activity, but is different from most other bacterial diseases in that no specific tissue reactivity has been demonstrated.

Several types of bacteria have been suggested as the etiologic agents of caries, the most common of which are streptococci and lactobacilli, which are both acidogenic and relatively aciduric. Streptococci are more numerous in saliva and plaques, but lactobacilli are capable of producing a lower pH in media. It has been shown that numbers

of salivary lactobacilli are correlated with degrees of caries activity which associates these organisms with the decay processes.³ Considerable work has been done to determine whether streptococci or lactobacilli are more intimately associated with caries and the work has been adequately reviewed by Rosebury.⁴

A number of individuals exist, apparently completely resistant to caries, who have been termed immune since they have no history of caries. This immunity has not been associated with age, sex, race, or dietary habits, but there is some evidence indicating a genetic factor in caries.⁵ In terms of the acidogenic theory of caries, it must be assumed that the organisms responsible for caries in susceptible persons are absent from immune mouths, or that the acidogenic activities of such organisms are either modified or neutralized in immunes. This would imply the operation of some mechanism in the immune mouth which inhibits or modifies the activities of potentially cariogenic microorganisms. This investigation was undertaken with the purpose of comparing the microflora of caries-resistant and caries-susceptible humans, and of studying the effect of saliva of both types on certain oral organisms.

Comparative quantitative examinations of gram negative rods, gram negative diplococci, yeasts, caseolytic organisms, streptococci, acidogenic streptococci, micrococci, acidogenic micrococci, and lactobacilli in salivas of a number of immune and susceptible persons were made, employing plate counts on suitable media. Of these organisms, only the lactobacilli occurred in significantly different numbers in the two groups, being about 400 times more numerous in the susceptible group. In addition, the lactobacilli from immune saliva were almost exclusively of smooth colony morphology, while 55 per cent of the lactobacilli isolated from susceptible salivas were of rough colony morphology. It was immediately considered that the conditions giving rise to low numbers of only one colonial type of lactobacilli in immune saliva might be involved in the mechanisms of caries immunity. Accordingly, intensive study of oral lactobacilli and the effect of immune and susceptible salivas was undertaken in an effort to discover the mode of operation of any factors peculiar to immune saliva which might account for the above observations.

The possibility was considered that rough colony types of lactobacilli, which were shown to exist almost exclusively in susceptible saliva, might be more active physiologically than smooth (S) types, since the former were associated with caries susceptibility. Routine examinations of caries-free subjects disclosed two persons with no history of caries who exhibited lactobacillus counts higher than the usual range in immunes, and who also had rough (R) and intermediate (I) colony type lactobacilli in their saliva. In accord with the commonly accepted association of lactobacilli in caries etiology, the possibility was suggested that these subjects might be in transition from immunity to susceptibility. Since observations on the R organisms from their salivas, called immune R type here, might yield additional evidence of immunity mechanisms, they were included in the study.

Studies of the physiology of lactobacilli on various laboratory media have shown that S strains from immunes and susceptibles are nearly indistinguishable in their capacity to grow on media, at varying pH, and in their acidogenic and aciduric capabilities. However, R strains

from immunes and susceptibles have been shown to be quite different in many respects. Immune R organisms appear less exacting, growing in a number of media in which susceptible R organisms do not grow, and the immune R organisms are more acidogenic on laboratory media. In addition the immune R colonies have dissociated to S types readily under the influence of tryptone or during growth in liquid media, conditions which have not affected susceptible R strains. Some of the variations induced from the immune organisms were readily reversible; others appeared to be resistant to reversal.

The immune R strains were shown to resemble S types from immunes and susceptibles in their physiology. However, distinct physiological differences were shown between immune and susceptible R strains. These facts may lend some credence to the idea that in the immune subjects from whom the R strains were isolated, the condition of immunity is perhaps deteriorating, allowing a relaxation of the strict conditions resulting in an all-smooth lactobacillus population.

Two rather general differences have been seen in comparing lactobacilli from immunes and susceptibles, without regard to colony morphology. Lactobacilli from susceptibles were somewhat more acidogenic in substrates consisting wholly or in part of saliva, but survival experiments indicated they were apparently less resistant to low pH in saline environment. Organisms from both groups grew equally well on solid media at pH 5.0, 7.0, and 8.0, while only the rather rare I types grew at pH 4.0.

Lactobacilli of the rough colony type were definitely associated with caries-susceptible persons, and it was recognized that these organisms might be primarily responsible for tooth decay. Therefore, the results indicating that R strains were less active physiologically and particularly less acidogenic on laboratory media than S strains were somewhat confusing. Thus if these R organisms were more active in contributing to decay, the presence of saliva must modify the acidogenicity of the organisms. This was in fact borne out by experiments testing acidogenicity in the presence of saliva where it was seen on a number of occasions that susceptible R strains were equally as acidogenic as S cultures from either immunes or susceptibles. This reaffirms the point made by other investigators that saliva is probably the key to the caries immunity problem, for many observations made in the absence of saliva may not be valid when considering conditions in the mouth.

It was observed that many of the lactobacilli isolated from saliva were capable of variation in colony morphology on laboratory media. It was found that the composition of media, its physical state, and its pH were factors affecting dissociation, and that immune R strains exhibited greater tendency to dissociation than other types. The capacity of these lactobacilli to dissociate under various conditions leads to the conclusion that the common methods of isolation and enumeration of salivary lactobacilli are in fact selecting out those organisms which grow according to the method used, and probably influencing the colony morphology of many of them. This means that perhaps the actual state of the flora may not be determined in entirety by the routine methods used.

Immune rough organisms were seen to dissociate to S colony morphology on tryptone glucose extract agar, a medium on which susceptible R organisms did not grow. Investigation of this medium led to the discovery that the

addition of tryptophane to media could induce both immune and susceptible R strains to dissociate to S type. It has been reported that the concentration of tryptophane in immune saliva is higher than in susceptible. It would appear that tryptophane may be involved in immune mechanisms, since the action of tryptophane parallels an effect of immune saliva in inducing dissociation.

Studies of acidogenicity of lactobacilli showed that freshly isolated strains could seldom produce acid in undiluted saliva of either type. In contrast, cultures maintained in the laboratory are more acidogenic in undiluted saliva. It has become evident in these studies that differences occur in the physiology of cultures during periods of maintenance on laboratory media.

It has been reported by Hill, et al.,⁶ that saliva is inhibitory to the growth of oral lactobacilli, and that immune saliva possesses this capacity to a greater extent than susceptible. Comparative turbidimetric studies of growth of lactobacilli in substrates consisting in part of saliva, performed in this investigation, have confirmed the results of other workers. A definite period of time, usually up to six hours after inoculation, in which growth did not occur was seen in cultures incubated with substrates containing immune saliva. During this period, the number of cells apparently decreased, and this was later substantiated by experiments in which counts of viable organisms were made by plating on suitable media. A few additional experiments indicated that organisms recovered after the period of inhibition were resistant to the mechanisms of inhibition when placed in fresh tubes of immune saliva. Data were also obtained showing that saliva in which lactobacilli had grown was no longer inhibitory to fresh organisms. Hence it would seem that growth inhibition in immune saliva is due to the presence of an inhibitory substance or mechanism of some kind, which is inactivated or exhausted by contact with susceptible cells. The selection of resistant organisms by immune saliva was confirmed to some extent by later work.

All morphologic types of lactobacilli isolated from immune and susceptible salivas which were tested were sensitive to the action of this inhibitory mechanism. Considering the quantitative data on salivary microflora, it might be assumed that an inhibitory effect of immune saliva for lactobacilli would be evidenced, since immunes have low lactobacillus counts. Furthermore, the quantitative data do not permit similar inferences concerning any of the other types which were counted, since they did not occur in significantly different numbers in immune and susceptible saliva. Thus the available evidence indicates that the effect of immune saliva is primarily directed against lactobacilli.

Investigation of the effect of saliva on oral lactobacilli has disclosed that immune saliva has pronounced effects upon the colonial morphology, acidogenicity and aciduric capacity of all types of lactobacilli tested. Experiments on the effect of saliva on colonial morphology of cultures during incubation showed that both immune and susceptible saliva could influence S to R and R to S dissociations, but the method of inducing these variations is different in immune saliva. The physiology of variants induced by contact with susceptible saliva resembled that of most other types of lactobacilli which have been studied. The variation induced by immune saliva however, resulted in the appearance of a new S type of organism, whose colonial morphology is distinct from other types. This new NS type

was further characterized by the fact that it did not appear when cultures were plated from immune saliva to media at pH 5, only on media at pH 7. Experiments showed that the NS variants were indeed nonaciduric. A number of subcultures on tomato juice agar disclosed that the organisms grew at pH 7 and not at pH 5. In some experiments, dissociation of some strains of lactobacilli to a nonaciduric form was not induced by a single 24-hour period of incubation in immune saliva, but required several repeated transfers. There apparently is a range of sensitivity for oral lactobacilli to the transforming principle of immune saliva, but it has been shown that nearly all strains are capable of undergoing variation to be nonaciduric form.

Additional study of the nonaciduric variants produced evidence that the acidogenic capacity of the organisms had also been affected by contact with immune saliva. With contact with susceptible saliva as a control, it was shown that nonaciduric variants induced by immune saliva were less acidogenic on laboratory media than the parent cultures. In contrast, incubation with susceptible saliva had no significant effect on acidogenicity of any of the cultures when examined on other media.

The turbidimetric measurements of growth of lactobacilli in substrates containing saliva showed that the inhibitory effect of immune saliva was exerted in the first six hours after inoculation. In the first experiment on the effect of saliva upon colony morphology, the NS nonaciduric organisms were first seen at six hours, which seemed to indicate that the processes of inhibition and variation were related. Quantitative data obtained during this experiment showed that inhibition had occurred in immune saliva prior to the appearance of the NS organisms. The majority of the organisms which grew after the period of inhibition were of nonaciduric character. An experiment was specifically designed to give quantitative and qualitative information on the apparent relationship of inhibition and appearance of variants. The results of this experiment showed definitely that the NS nonaciduric variants appeared immediately after the period of inhibition, and that the majority of the organisms growing later than six hours after inoculation were nonaciduric. Thus, the immune saliva had primarily selected organisms which were nonaciduric, and the remaining aciduric organisms exhibited only limited capacity to grow after the inhibition period.

The results of these investigations afford a basis upon which a hypothesis of the mechanisms of immunity to dental caries may be formulated. The experimental data show that lactobacilli exist in much lower numbers in immune than in susceptible saliva; that immune saliva has a greater inhibitory capacity for lactobacilli, and that it has the property of inducing variants of lactobacilli which are nonaciduric and somewhat less acidogenic than the parent organisms. If the effects seen in the laboratory occur in the mouth, then immune saliva is able to manage the lactobacillus population to such a degree that the numbers of lactobacilli are reduced, and the majority of the remainder are nonaciduric. It may be assumed that dissociation to nonaciduric form takes place shortly after the organisms come in contact with the saliva, and that those which gain entrance to the plaques are primarily of this nonaciduric type. In terms of the acidogenic theory of caries, when fermentable carbohydrate is taken into the immune mouth and acid is produced by organisms in the plaques, once the concentration of acid reaches a sufficient level somewhere around pH 5, the nonaciduric

lactobacilli then begin to die off, thus reducing the numbers of potentially acidogenic organisms in the plaques. Since the nonaciduric lactobacilli do not grow at pH 5, which is considered the upper limit required for enamel decalcification, this mechanism which reduces the number and activity of lactobacilli could be effective in preventing initiation of caries. It is generally accepted that the lactobacilli are most instrumental in producing pH's below 5.0 in the plaque, and, thus, if the lactobacilli were inactivated, plaque pH might seldom if ever fall below 5.0.

The efficiency of the mechanism in immune saliva which induced dissociation to nonaciduric types cannot be expected to be complete, since aciduric lactobacilli can be regularly isolated from many of the caries immune subjects which were examined in this study. It is expected there may be genetic differences in sensitivity to this factor, which would render a few strains rather resistant. Also some of the aciduric lactobacilli which have been isolated from immunes may not have been in contact with saliva long enough for the nonaciduric variation to have taken place. It is possible that further studies might extend this proposed mechanism of immunity to other members of the acidogenic oral flora, but there is at present no evidence for or against this idea. It is also possible that immune saliva may have other effects on lactobacilli which have not yet been detected which would contribute to reducing their acidogenic or growth potentialities.

It may be concluded that this study of oral lactobacilli and the effects of saliva upon them have afforded a reasonable hypothesis concerning the mechanisms of immunity to dental caries. Microfilm \$2.00; Xerox \$5.00. 98 pages.

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TISSUE CULTURE OF AEDES AEGYPTI CELLS AND ITS APPLICATION IN STUDIES ON THE BEHAVIOR OF EASTERN EQUINE ENCEPHALOMYELITIS VIRUS

(L. C. Card No. Mic 59-1905)

Thomas Walton Haines, Ph.D.
University of Maryland, 1958

Supervisor: Professor William Bickley

Over 650 immature tissues of *Aedes aegypti* Linnaeus were tested for survival or possible development in vitro using 40 different culture media combinations.

Definite cell development was demonstrated in tissues of embryo, larval midgut, pupal ovary and minced head and thorax of pupae. All tissues showed a wide range in survival in vitro.

Initial growth was demonstrated by the occurrence of mitotic figures adjacent to the cut end of the pupal ovary.

A small mass of fibroblast-like cells was observed in cultures of minced embryo tissues and minced head and thoracic tissues of pupae.

Exposure of larval midgut cells to eastern equine encephalomyelitis virus did not appear to enhance survival of the virus during a 5-day test period.

Daily measurement of nuclei of developing midgut cells in vivo compared with developing normal cells in vitro showed remarkable similarity in the average size and in the number of nuclei in both in vivo and in vitro cultures.

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Positions held:

Biologist, U. S. Public Health Service, Communicable Disease Center, 1944-1948.

Entomologist, U. S. Public Health Service, Communicable Disease Center, 1948-1954.

Medical Entomologist, Chemical Corps, U. S. Army, 1954-1958.

Microfilm \$2.00; Xerox \$3.00. 51 pages.

NUTRITIONAL SYMBIOSIS THROUGH MICROBIAL ASSOCIATIONS

(L. C. Card No. Mic 59-1913)

Leo Francis Judge, Jr., Ph.D.
University of Maryland, 1958

Supervisor: Dr. Michael J. Pelczar, Jr.

Nutritional symbiosis between several species of bacteria has been observed in chemically-defined media

deficient in one or more vitamins and amino acids. Growth of the individual symbionts in the association generally approached the amount obtained in a complete medium.

Such symbiotic responses were obtained by combining (in pairs) species of *Lactobacillus* with species of *Streptococcus*, *Staphylococcus*, *Leuconostoc* or *Neisseria*; *Streptococcus* with *Leuconostoc* or *Staphylococcus*; and *Staphylococcus* with *Leuconostoc* or *Neisseria* in various media which would not support the growth of these organisms when inoculated individually.

In the study of the associations between six strains of the genus *Staphylococcus* with *Streptococcus fecalis* (strain R) the initiation of the symbiotic response was affected by the size of the inoculum. The ability of a limited but measurable amount of growth by the individual symbionts in the deficient medium resulted in elaboration of essential nutrients for each member of the pair. It was further found that each symbiont was able to grow in the filtrate from the other when the latter had previously been cultured in a medium deficient for the former.

The results obtained with microbiological assays employing lactic acid bacteria and biochemical mutants of *Escherichia coli*, as well as with paper chromatography, indicate that pantothenate, threonine and probably serine were excreted preformed, either free or in conjugated form, by some species of *Staphylococcus*. Proline and phenylalanine were found to be excreted by *Streptococcus fecalis* R. By means of inhibition studies with *Staphylococcus aureus* strains, evidence is presented to indicate that a substance with folic acid activity was produced by these organisms, but it appears doubtful that it is a known form of folic acid. The mechanism of its synthesis is obscure. The results of these studies indicate the possibilities of the existence of unique relationships between microorganisms growing in association.

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Microfilm \$2.00; Xerox \$5.00. 98 pages.

STUDIES ON THERMALLY INDUCED CHANGES IN THE BACTERIAL ENDOSPORE AND ON THE RELATIONSHIP OF ITS CHEMICAL COMPOSITION TO THERMAL RESISTANCE

(L. C. Card No. Mic 59-2033)

Richard Victor Lechowich, Ph.D.
University of Illinois, 1959

Spores of *Bacillus subtilis* were heated at temperatures of 45, 80, 85, and 90 C for selected periods of time in order

to stimulate the release of dipicolinic acid (DPA) from the spores. The thermal resistance properties of these spores were compared to unheated control spores. The results indicated there was no correlation between the amount of DPA lost from the spores and their subsequent thermal resistance.

Data were also obtained on the rate of release of ninhydrin positive material from spores heated at 80, 85, and 90 C. The rates of release of DPA and ninhydrin positive material were similar and increased as the temperature of heating was increased.

The rates of release of DPA, calcium, magnesium, and manganese were followed when *Bacillus subtilis* spores were heated at 100 C. Manganese was excreted most rapidly and was followed by DPA, calcium, and magnesium.

The composition of the exudate from *Bacillus subtilis* spores, heated at 100 C in distilled water, contained DPA, cations and other unidentified material. The 65 minute exudate contained DPA chiefly as the free acid, even though the intact spores contained calcium in excess of that needed to form the calcium salt or chelate of DPA.

The DPA and cation contents were obtained for spores of *Bacillus subtilis* and *Bacillus coagulans* (thermoacidurans) which possessed different degrees of resistance to heat.

Vegetative cells of *Bacillus coagulans* (thermoacidurans) were not resistant to heat and did not contain DPA, while spores of this organism required 75 minutes of heating at 98 C to destroy nearly all of the spores. These spores contained about 8 percent DPA and also contained 4.5 times the calcium, 6 times the manganese, and approximately the same magnesium content as the parent vegetative cells.

The thermal resistance of spores of *Bacillus subtilis* was varied by growth at three different sporulation temperatures and their chemical composition examined. The thermal resistance and cation content increased as the sporulation temperature increased from 29 to 30 to 45 C.

Spore crops of *Bacillus coagulans* (thermoacidurans) were produced at sporulation temperatures of 30, 45, 50 to 54, and 53 to 54 C. The thermal resistance of these spore crops increased in the following order: 30, 45, 53 to 54, and 50 to 54. Analyses of these spore crops indicated no direct relationship between chemical composition and thermal resistance.

The ratios of the millimoles of cations to the millimoles of DPA were calculated for each of the spore crops of *Bacillus coagulans* (thermoacidurans). The ratios found were: 0.818, 30 C spore crop; 1.36, 45 C spore crop; and 1.95, 50 to 54 C spore crop. It was postulated that the observed excess equivalent amount of cations in comparison to the DPA might enter into a cation-protein dipicolinic acid complex which rendered certain critical proteins less sensitive to denaturation by heat.

Similar calculations were performed on the *Bacillus subtilis* spore crops. In this case the ratios were: 1.09, 29 C spore crop; 1.04, 30 C spore crop; and 1.38 for the 45 C spore crop.

Sonic disruption of the 45 C crop of *Bacillus coagulans* (thermoacidurans) indicated that essentially all of the DPA and calcium found in the spore were in the cytoplasm. The data also indicated that the greater portion of the manganese was in the cytoplasm and that the magnesium was equally distributed throughout the cell.

Microfilm \$2.00; Xerox \$5.80. 118 pages.

ENERGY COUPLING IN DESULFOVIBRIO DESULFURICANS

(L. C. Card No. Mic 59-1856)

Byron John Mechalas, Ph.D.
University of Southern California, 1959

Chairman: Professor Rittenberg

The purpose of this investigation was to test the hypothesis that an organic molecule can serve exclusively as a hydrogen donor and energy source for autotrophic growth. The experimental work was carried out using isotopic tracers and organic substrates that could be oxidized but not assimilated.

The organism chosen for these studies was *Desulfovibrio desulfuricans*. This organism was considered ideal for this type of investigation for two reasons: (1) It is described in the literature as a facultative autotroph; (2) it has limited oxidative abilities when grown heterotrophically, oxidizing alcohols almost quantitatively to the corresponding organic acid. The strain used in this study was checked for these properties, and it was found that it could grow to a limited extent in a strictly autotrophic medium and that alcohols were oxidized to the corresponding acids.

Through the use of Thunberg experiments it was determined that three organic compounds—*isobutanol*, *phenylethanol*, and *phenylpropanol*—could serve as test substrates. These appeared to be oxidized but not assimilated by the bacteria.

It was found that yeast extract alone or yeast extract plus carbon dioxide did not support appreciable growth. If a hydrogen donor was included in the medium—either hydrogen gas, *isobutanol*, or *ethanol*—growth was stimulated. Under these conditions, growth increase was proportional to the yeast extract concentration at a constant level of hydrogen donor or to hydrogen donor concentration at a constant level of yeast extract. Growth in the presence of hydrogen gas and carbon dioxide alone, i.e., strictly autotrophic conditions, was scanty.

Using radioactive carbon dioxide, it was found that the per cent incorporation of carbon dioxide in cell material was lowest in a yeast extract plus carbon dioxide medium, about 3 per cent. In media containing a hydrogen donor (hydrogen gas, *ethanol*, or *isobutanol*) plus yeast extract and carbon dioxide, incorporation ranged from 7 to 12 per cent with no significant difference between the different hydrogen donors. The per cent incorporation was highest in a "strictly" autotrophic environment, carbon dioxide plus hydrogen gas without yeast extract, but even here amounted to only 25 per cent, suggesting growth to a considerable extent on organic contaminants in the medium. The data suggest that carbon dioxide assimilation under all but the "strictly" autotrophic experiments was most probably of the heterotrophic type.

Total counts incorporated in general paralleled total growth under all conditions.

When tagged *isobutanol* was used as a hydrogen donor, it was found that a medium containing *isobutanol* plus yeast extract plus carbon dioxide gave excellent growth but that less than 2 per cent of the carbon arose from the *isobutanol*.

From these data it was obvious that the initial hypothesis was neither confirmed nor rejected. However, the findings led to the equally interesting conclusion that

Desulfovibrio desulfuricans can couple the energy derived from either an inorganic (hydrogen gas) or organic (*isobutanol*) hydrogen donor to the assimilation of an organic carbon source different from the hydrogen donor.

Microfilm \$2.00; Xerox \$4.80. 95 pages.

STUDIES ON A GROWTH STIMULANT(S) PRODUCED IN THE CULTURE FILTRATE OF BACILLUS GLOBIGII GROWN IN A CHEMICALLY DEFINED MEDIUM

(L. C. Card No. Mic 59-2491)

Nassim Hanna Nabbut, Ph.D.
The University of Texas, 1959

Supervisor: Dr. V. T. Schuhardt

Evidence has been presented that delayed growth of *Bacillus globigii* in a chemically defined medium is associated with the production of an endogenous stimulant to growth initiation which is accumulated in the cells and in the culture medium. The distinctive effect of this growth stimulant (designated "filtrate factor" or FF) is a marked reduction in growth lag of *B. globigii* inoculated into an otherwise adequate chemically defined medium.

A procedure for the assay of the stimulatory activity was devised, based upon the growth response (turbidity) to graded concentrations of the filtrate factor within a limited incubation period. Comparison of the growth stimulatory activity of dilutions of the filtrate obtained at different stages of the growth cycle showed a good correlation between the degree of growth and the filtrate factor activity. It also indicated that the accumulation of the filtrate factor begins at an early stage of the culture cycle, being maximal at the maximum growth density.

The manner by which the filtrate factor exerts its stimulatory effect seems to be that of shortening the lag time, relative time required by the culture to achieve just visible turbidity, of inoculum cells rather than of accelerating the growth rate. Once growth has been initiated in the absence of the filtrate, it proceeds at approximately the same rate as that which occurs in its presence. No significant difference was found in the final turbidity of the cultures whether they initially contained the filtrate or not. Experimental evidence seems to support the conclusion drawn from turbidity time curves, that the filtrate factor functions both to initiate and maintain a rapid, exponential cell division process.

The addition of the filtrate, obtained from fully grown cultures, abolished the prolonged lag produced by certain inhibitors (phenol, acetone, G-11). It has been postulated that such filtrates serve as a source of some metabolites or their immediate precursors which are essential to the initiation of the cell division. Such essential metabolites are produced in adequate quantities in normal growth.

It has also been postulated that during the normal growth of *B. globigii* the cells may synthesize an endogenous chelating agent(s) which is excreted into the medium. Such an agent may promote growth initiation by providing the cells with a non-toxic assimilable form of manganese (or other metals) which is an essential component of the enzymes involved in the division processes of the organism.

The filtrate factor does not owe its stimulatory activity to a volatile or thermolabile component of the filtrate. It is acidic in nature, adsorbed with acid washed charcoal from which it can be partially eluted with different eluting agents. This latter observation provided evidence for the presence of at least two factors in the filtrate; the major factor is adsorbed on charcoal, while the other factor stays in the effluent. Both factors act synergistically in the stimulation of growth. Some evidence has been presented that the "artificial" stimulant (GP) and the natural stimulant (FF) have some properties in common although they differ in some others which makes it rather improbable that the two are chemically identical.

Microfilm \$2.00; Xerox \$6.60. 137 pages.

NUTRITION AND CARBOHYDRATE METABOLISM IN *VIBRIO COMMA*

(L. C. Card No. Mic 59-2050)

A. K. M. Mahboobur Rahman, Ph.D.
University of Illinois, 1959

A satisfactory medium, tryptone 1.0 per cent and yeast extract 0.5 per cent, pH 7.5 was found suitable for the growth and maintenance of *Vibrio comma*. The organism dies rapidly at low temperatures (4°C) and survives for a long time at room temperature, even without added nutrients.

Vibrio comma cannot grow in synthetic media or utilize glucose as carbon source unless some growth promoting materials such as acetic, succinic and aspartic acids or some organic or inorganic sulfur compounds are added to the media. The organic metabolic acids must be transported inside the cell to promote growth. The presence of amino group(s) in the molecule apparently facilitates the transport possibly by reducing the overall acidic character.

In the presence of thiosulfate, glucose, fructose, sucrose, maltose and starch are readily utilized for growth. Galactose is utilized poorly, ribose adaptively and lactose and arabinose not at all. An inducible hexose monophosphate pathway is probably present in *V. comma*.

Very small amounts of inorganic phosphate suffice for anaerobic glycolysis. However, growth and respiration with glucose as substrate require the presence of much larger amounts of inorganic phosphate. Respiration and the glycolytic activity are completely inhibited by any slight adverse treatment of the cells.

Inhibition studies indicate that the Embden Meyerhof pathway is exclusively utilized anaerobically and an alternative pathway(s), besides Embden Meyerhof, is operative aerobically. *Vibrio comma* fermentations are characterized by the formation of formic, acetic, lactic and succinic acids and ethanol and by the complete lack of gas production. The relative amounts of acids formed during fermentation vary with change of pH. The quantitative relationship of the fermentation acids produced are markedly influenced by the concentration of inorganic phosphate and/or bicarbonate.

Fermentation balances are characterized by 80 - 90 per cent carbon recovery and low oxidation/reduction values. Oxalic and glyoxalic acids have been tentatively identified as new products of *V. comma* fermentation.

Isotopic studies prove the exclusive operation of the Embden Meyerhof pathway during anaerobic glycolysis.
Microfilm \$2.00; Xerox \$5.20. 105 pages.

THE HOST RANGE OF AN ENTERIC CYTOPATHOGENIC ORPHAN "ECBO" VIRUS ISOLATED FROM HEALTHY DAIRY CATTLE

(L. C. Card No. Mic 59-1340)

Abbas Mohamed Soliman, Ph.D.
Michigan State University, 1958

Supervisor: W. N. Mack

A virus isolated from the stools of "healthy" dairy cattle was tested for its host range.

The virus was found to multiply in the amniotic cavity of White Leghorn embryonated eggs, and after several passages, the agent was adapted to the allantoic sac.

When the virus was injected intracerebrally into adult mice, hamsters, white rats, cotton rats, guinea pigs, cats, dogs, chicks and chickens, no evidence of disease was found in these animals.

Suckling mice and hamsters were found to be susceptible to the virus. Both animals developed paralysis followed by death. The virus could be maintained serially in both suckling mice and hamsters.

Two calves were exposed to this virus. The first animal was given the virus per os. Although the animal died after 4 days, it was thought that death was not produced by the virus. The virus was recovered from the animals intestinal content. A second calf was injected intravenously with the virus. This animal showed no symptoms of disease although the virus could be recovered from the feces for 13 days following inoculation.

Neutralization tests were done on paired sera from cats, dogs, chickens and one calf. Only the calf's post-inoculation serum sample showed evidence of antibodies to this virus.

Antiserum, for a different enteric virus isolated from cattle, did not neutralize the virus under study; indicating that there are probably several antigenic different enteric viruses in cattle.

Microfilm \$2.00; Xerox \$4.00. 71 pages.

PIGMENTATION IN SELECTED STRAINS OF STREPTOMYCES WITH PARTICULAR REFERENCE TO POLYENES AND PORPHYRINS

(L. C. Card No. Mic 59-1830)

Irvin David Steinman, Ph.D.
Rutgers University, 1959

Major Professor: Dr. Hubert A. Lechevalier

Studies were made concerning the conditions favoring production of a variety of pigments by the neomycin-producing strain of *Streptomyces fradiae*. The addition of high concentrations of calcium salts to shake cultures of

yeast-dextrose broth favored the production of a deep green pigment. Spectrophotometric examination of yellow butanol extracts obtained from these cultures indicated that a hexaenic polyene was also being synthesized under these conditions. This substance was tested and found to have no biological activity.

Further investigation on the effects of high concentrations of calcium were made using *S. lavendulae*, strain 3440-14, producer of streptothricin, and *S. aureus*, strain 3569, which had once possessed and then lost the ability to synthesize the anti-fungal tetraene antimycin. During these experiments a hitherto unreported, biologically active pentaene was found to be synthesized by *S. lavendulae*. Divalent ions, including calcium, did not increase production of this polyene when the streptomycete was grown on yeast-dextrose broth but had a marked stimulatory effect on its synthesis in a basal synthetic medium.

Calcium salts also have the property of inducing the synthesis of antimycin in *S. aureus*. Magnesium showed an additive effect, increasing the yield of antimycin obtained in the presence of calcium salts. The further addition of mevalonic acid (beta, delta-dihydroxy-beta-methylvaleric acid) shortened the time necessary for production of the tetraene from 7 to 2-3 days, and increased the yield.

When *S. aureus* was grown on unsupplemented basal medium (no added salts or mevalonic acid), butanol extracts made under acid conditions, pH 4 to 5, appeared bright red and were found to contain quantities of a porphyrin excreted by the cells. This porphyrin was identified as coproporphyrin III. Cultures producing good yields of antimycin did not lose porphyrin. Labelled 2-C¹⁴ mevalonic acid was shown by a number of methods not to be incorporated into the tetraene. Some evidence is presented which indicates that it is a precursor of coproporphyrin III.

The hypothesis is proposed that coproporphyrin III is an intermediate in the synthesis of some active porphyrin enzyme necessary for polyene synthesis. A block occurs when the organism is grown on basal synthetic media, resulting in the accumulation of excess coproporphyrin III. When high concentrations of calcium and magnesium are present, loss of the porphyrin from the cell is apparently prevented. The addition of mevalonic acid further stimulates synthesis of the active porphyrin enzyme, as evidenced by an increase in the synthesis of antimycin. It is postulated that the organism probably produces mevalonic acid or some related compound, since antimycin synthesis will occur, although it is delayed, when only the divalent ions are added to the medium. The nature of the hypothesized enzyme is as yet unknown.

Microfilm \$3.35; Xerox \$11.40. 258 pages.

THE INTESTINAL FLORA OF THE PIG AS INFLUENCED BY DIET AND AGE

(L. C. Card No. Mic 59-2427)

Robert Daniel Wilbur, Ph.D.
Iowa State College, 1959

Supervisors: Damon V. Catron and
Lloyd Y. Quinn

Studies have been conducted on the intestinal and fecal microorganisms of the pig to determine how they vary with diet, age, management, and litter. Using purified diets with casein as the source of protein, beta-lactose was far superior to raw corn starch as the source of carbohydrate and individually-fed pigs showed a faster rate of gain than group-fed pigs.

The organisms studied in these experiments were the total aerobes, total anaerobes, lactobacilli, coliforms, streptococci, staphylococci, and molds and yeasts. In experiments on the effects of diet and management, the group-fed pigs generally had higher counts and showed lower coefficients of variation in most organisms studied than those individually fed. Also, significant effects were observed with regard to litters and replication.

The influence of diet was studied using 48 pigs weaned at two weeks of age and fed to six weeks of age at which time half of the pigs were sacrificed and bacteriological examinations made on duodenal, ilial, cecal, and rectal contents. All fecal organisms with the exception of the total anaerobes and lactobacilli were lower in numbers when lactose was the carbohydrate fed as compared to starch. Furthermore, the coliforms, streptococci, staphylococci, and molds and yeasts were also lower in numbers with lactose feeding in all sections of the intestinal tract sampled. With most organisms studied counts increased sharply from the duodenum to cecum and only slightly from the cecum to rectum. The influence of diet on rectal counts generally reflected similar changes throughout the intestinal tract with variations occurring mainly in degree.

Indications are that the intestinal tract of the newborn pig is relatively devoid of microbial growth, but within 24 hours these populations reached their greatest density in terms of viable cells. Most of the organisms studied showed a general decline from one day of age up to weaning (two weeks of age) at which time they rose sharply in numbers to a level just below that attained at one day of age and then remained fairly stable. The coliforms, however, seem to follow a general tendency to decline in numbers from one day of age to market weight.

Of the groups of organisms studied, the total anaerobes, total aerobes, and lactobacilli were generally predominating in numbers with the streptococci, coliforms, staphylococci, and molds and yeasts usually following in that order. Of course, these relationships were influenced to a certain extent by age and also by location in a specific section of the intestinal tract.

Of the organisms isolated from selective media the majority of gram-negative rods were *Escherichia coli*, of gram-positive rods were *Lactobacillus fermenti*, and of gram-positive cocci were *Streptococcus faecalis*.

Microfilm \$2.00; Xerox \$4.40. 84 pages.

TRANSPORT THROUGH THE RABBIT OVIDUCT

(L. C. Card No. Mic 59-2462)

Donald Leighton Black, Ph.D.
Cornell University, 1959

Oil or India ink placed in rabbit oviducts is rapidly dispersed by segmentation and pendular movements. Neither oil nor India ink passed into the uterus but was stopped 2-3 cm. anterior to the tubo-uterine junction.

Ligation of the infundibular end of the oviduct resulted in distention of the tubal wall. Distention was less frequent and fewer eggs were recovered from ligated oviducts in which small plastic tubing was placed through the tubo-uterine junction. Histological examination of the junction revealed no information as to the nature of the barrier.

Tubal distention of ligated oviducts normally recedes between the 48th and 72nd hours after copulation. Large amounts of estrogen prolongs distention but progesterone does not diminish distention at 48 hours post coitum. Progesterone increased the speed of ovum transport to the extent that some were found in the uterus 60 hours post coitum.

Photokymographic records of oviduct circular muscle revealed that activity generally decreases from the ovarian to the uterine end. No effect of time on activity was observed.

Circular muscle can account for both spermatozoon and ovum transport. The gradient of circular muscle is related to the speed of ovum transport through the various segments. The barrier at the uterine end of the tube, which is controlled by the ovarian hormones, prevents the premature entry of ova into the uterus and aids in spermatozoon transport by causing a proovarian flow of tubal secretions. Microfilm \$2.00; Xerox \$4.60. 87 pages.

ERYTHROCYTE ANTIGENS IN A RANDOM
BRED POPULATION OF SINGLE COMB
WHITE LEGHORN FOWL

(L. C. Card No. Mic 59-2693)

Donald Preston Doolittle, Ph.D.
Cornell University, 1959

Iso-immune antisera, prepared by immunization between members of the Cornell random-bred population of Single Comb White Leghorn fowl, were studied. Unabsorbed sera were used, so that greater quantities of serum would be available for tests. Estimates of the probability of an erroneous determination were obtained, and three of the original ten sera discarded because of high error rates.

The relationships among the seven remaining sera were studied, and the conclusion drawn that the sera were highly complex. The applicability of Todd's rule, that no individ-

ual reacts with a serum to which neither parent will react, was tested. Todd's rule could not be definitely rejected for any of the seven sera, although there were indications that it might not apply to three of them.

Other tests indicated that sex-linked genes, whether dominant or recessive, were not likely to be important in causing reaction to the sera. Also, if reactions were due purely to the action of recessive genes, more than one locus was involved, and the same recessive genes were carried in more than one of the four G_0 lines.

Because of the complexity of the sera, procedures designed to test the applicability of certain simple modes of inheritance were not used; the procedures were, however, set forth, with examples of the calculations involved.

Tests of the relationship of reaction to performance in several traits of economic value indicated that this performance did not depend on the antigen phenotype. The distribution of phenotypes differed in the two hatches for four sera, and in the sexes in three sera, possibly indicating a natural selective advantage for some genotypes related to antigen production.

Errors and problems found in the conduct of the investigation were pointed out, and suggestions made for a revision of the procedures.

Microfilm \$2.00; Xerox \$5.80. 116 pages.

STUDIES ON THE X-RADIATION BREAKAGE OF
NUCLEIC ACID IN TOBACCO MOSAIC VIRUS

(L. C. Card No. Mic 59-2395)

Sol Walter Englander, Ph.D.
University of Pittsburgh, 1959

Lauffer, Trkula, and Buzzell have reported that both x- and ultraviolet irradiation of whole tobacco mosaic virus (TMV) have the effect of decreasing the viscosity of extracted virus nucleic acid strands (RNA). They surmised that breakage of the strands had occurred and suggested that this might be the mechanism for the radiation killing of the virus.

We have studied the physical effect of x-rays on TMV-RNA by means of the analytical ultracentrifuge using ultraviolet absorption optics. The results give strong evidence that breakage does occur. When the virus is irradiated in solution at 0°C., we find a 1:1 relationship between killing of the virus and breakage of previously intact RNA strands. However, when the virus is x-irradiated near dry ice temperature, the rate of breakage, as measured in the ultracentrifuge, is decreased while the rate of loss of virus activity, as measured in greenhouse *N. glutinosa*, is unchanged. Attempts to develop possible latent breaks by heating of the virus and the extracted nucleic acid were unsuccessful.

Direct x-irradiation of extracted, dry ice frozen

TMV-RNA induced breakage approximately equal to that of RNA in frozen TMV, but here mild heating developed further breakage. The breakage following heating was equal to that found for RNA from TMV irradiated in solution. (The results cited in this paragraph were obtained by J. A. Wohlhieter.)

Microfilm \$2.00; Xerox \$3.00. 33 pages.

RELATION BETWEEN MEANS AND COMPONENTS
OF GENOTYPIC VARIANCE IN BIPARENTAL
PROGENIES OF A VARIETY OF MAIZE

(L. C. Card No. Mic 59-2416)

George Richard Gwynn, Ph.D.
Iowa State College, 1959

Supervisor: Lowell H. Penny

The genotypic variance due to the collective action of genes influencing quantitative attributes may be partitioned into (1) a portion due to additive genetic variance, (2) a portion due to dominant deviations from the additive scheme and (3) a portion due to epistatic deviations from the additive scheme. By assuming absence of epistasis estimates of additive genetic variance and dominance variance may be obtained from the analysis of variance of biparental progenies.

In this study a sample of ten S_0 plants and their S_1 families was chosen at random from an improved strain of the corn variety Krug and within each S_1 family biparental progenies were made up. The testcross and S_1 progeny performance of each of the parental S_0 s was correlated with the estimates of additive genetic variance and dominance variance. Observed correlations were low in most cases. Adjusted correlations indicated that where additive genetic variance was highly correlated with S_1 or testcross performance then the corresponding dominance correlations were low and vice versa. In general positive correlations were indicated between additive genetic variance and S_1 progeny yield and between dominance variance and testcross yields.

Tests of significance revealed significant amounts of additive genetic variance for each character measured in almost every S_1 family. The estimates obtained for dominance variance were rather low. There was a considerable range in additive genetic variance among the ten families. Estimates of heritability in the narrow sense were computed and they reflected the range in estimates of additive genetic variance.

Estimates of interaction of average gene effect with environments experienced in the two years of test indicated some cases of significant interaction in all characters measured except kernel row number. The same general results were obtained in estimating the interactions of dominance deviations with environments.

Ratios of dominance variance to additive genetic variance were computed in an effort to get some idea of the type of gene action involved. Some of the values obtained fell in the range indicative of overdominance but it must be pointed out that such values may have been due partly, at least, to the sampling variation obviously present.

Microfilm \$2.00; Xerox \$4.60. 89 pages.

STUDIES ON THE PHENOMENON OF
PREFERENTIAL SEGREGATION IN MAIZE

(L. C. Card No. Mic 59-2031)

Gary Yoshinori Kikudome, Ph.D.
University of Illinois, 1959

Normally in heterozygotes such as Aa , the alleles A and a are recovered with equal frequencies. In maize, there is a type of chromosome 10 known as "abnormal 10" which is responsible for a deviation from this expectancy. During megasporogenesis in plants heterozygous for abnormal 10, the abnormal chromosome 10 is preferentially segregated to the functional basal megaspore with a frequency of approximately 70 per cent. Preferential segregation for loci in chromosome 10 is not observed in plants homozygous for either the normal or the abnormal type of chromosome 10. It has been shown by Longley and by Rhoades that the abnormal chromosome 10 causes other chromosomes of the complement to segregate preferentially whenever one homologue is knobbed and the other is knobless. As is the case with abnormal 10, preferential segregation does not occur when both homologues are knobless.

Experiments were conducted to determine whether the size of the knob on chromosome 9 has any effect on the degree of preferential segregation. Knobs of three different sizes were utilized. In each situation the knobbed chromosome was opposed by a knobless homologue. It has been shown that, in general, the larger the knob the greater is the degree of preferential segregation for the loci associated with that knob. It has also been shown that whenever one homologue of chromosome 9 has a knob larger than that on the other homologue, preferential segregation favors the chromosome with the larger of the two knobs.

In both chromosomes 9 and 10, the genetic markers closer to the knob show a progressively higher degree of preferential segregation than those further removed from the knob.

It was found that the frequency of recombination is much lower in plants segregating for a large knobbed and a knobless chromosome 9 when only normal chromosome 10 was present than in plants heterozygous for a smaller knobbed and a knobless chromosome 9. In the presence of abnormal 10, however, the recombination frequency is increased to about the same level (30 per cent). Evidence favors the hypothesis that abnormal 10 increases the frequency of crossing over and that preferential segregation is a function of crossing over.

Using appropriate markers on chromosome 10, it has been shown that there is considerable crossing over in the chromosomal segment distal to the R locus. In plants heterozygous for R and $Sr-2$ but homozygous for normal 10, the recombination frequency observed between these two loci was approximately 36 per cent. In sib plants heterozygous for abnormal 10, the recombination frequency was drastically reduced to about 1 per cent. This reduction is understandable since the distal one-sixth of the long arm of abnormal 10 is not homologous to the corresponding segment of the long arm of normal 10. In plants heterozygous for R and $Sr-2$ and abnormal 10, crossovers between these two genes always occurred to the left of the three small chromomeres present in the long arm of abnormal 10.

Microfilm \$2.00; Xerox \$4.40. 82 pages.

STUDIES IN THE BUILDING OF LARGE CHROMOSOME RINGS IN BARLEY

(L. C. Card No. Mic 59-2363)

Malcolm Duncan MacDonald, Ph.D.
University of Minnesota, 1959

Adviser: C. R. Burnham

This study included attempts in barley to build rings with a large number of chromosomes by selection of crossovers in the differential segment in the progenies of crosses between translocations with a common chromosome. The interchanges crossed were

C1483 (b-g) x Ert 7 (a-b), C1358 (b-d) x C1483 (b-g), XT4 (c-f) x XT13 (c-g), C1025 (b-d) x XT15 (d-f), XT15 (d-f) x C1358 (b-d), C1433 (f-g) x XT4 (c-f), C1483 (b-g) x C1433 (f-g), and C1483 (b-g) x XT13 (c-g).

The common chromosome was b in two different crosses, c in one, d in two, f in one, and g in two. The crosses underlined were the ones which, on the basis of previous cytogenetic information, should have had a long differential segment. Selection of possible crossovers in F_2 progenies and in test crosses (normal x F_1) was made on the basis of pollen and ovule sterility and cytological analysis at meiosis.

Although the average number of plants classified for each of the eight crosses was 1256 (range 922 to 2160), not a single crossover was obtained that combined the two interchanges. The few in each progeny that were classed as other than non-crossovers included a number of plants identified cytologically as trisomics and a number that were sterile and probably trisomic. Failure to identify a plant with the crossover may have been the result of (1) an inadequate method of selection, although selection did identify some trisomics with sterility similar to that expected for the crossover, and (2) greatly reduced crossing-over in the differential segment plus either a very low frequency of crossing-over in the appropriate interstitial segment and alternate segregation of centromeres or a very low frequency of the appropriate adjacent-alternate segregation.

Plants with a 96 had about 50 per cent pollen abortion. The segregation of '50 per cent sterile' and normal plants in the progenies of plants with a complex of six chromosomes was close to the expected 1:1 ratio in all but one cross, C1025 x XT15. This hybrid, which formed chains as well as rings of six chromosomes, had an excess of '50 per cent steriles' in two out of 10 progenies. The cause of this deviation was not established, but it may have been a chance deviation.

The cytological position of the Ert 7 (a-b) interchange on chromosome a was determined from measurements made of pachytene chromosomes from a plant heterozygous for the interchanges C1483 (b-g) and Ert 7. The position, measured from the centromere, is at 0.17 on the short arm of chromosome a or 5. This Ert 7 translocation point is denoted as 5S·17.

Cytological analysis, at meiosis, of hybrids of different b-g interchanges provided information on the probable positions of the translocation breakage points. The observed chromosome configurations at metaphase in the F_1 were C1483 x C1315 a 04, C1483 x C1376#2 a 04 and 7II, C1483 x C1462 a 04, C1315 x C1376#2 a 04 and chain of four, C1315 x C1462 7II, and C1376#2 x C1462 a 04 and

chain of four. Since root tip studies definitely established the breaks in C1483 to be in the short arm of b and the satellite or short arm of g, the probable chromosome arms involved in the other interchanges based on the F_1 configurations at meiosis are: C1315 b-L, g-L; C1462 b-L, g-L, and C1376#2 b-S, g-L.

It is suggested that the stability of a large ring of chromosomes built by selecting crossovers in the differential segment may not be as great as a ring produced by irradiation with no selection for crossing-over in this region.

Microfilm \$2.00; Xerox \$5.00. 96 pages.

FERTILITY STUDIES OF AUTOTETRAPLOID VARIETIES AND HYBRIDS OF COMMON BARLEY, HORDEUM VULGARE L.

(L. C. Card No. Mic 59-1791)

Warren Edward Smith, Ph.D.
The University of Nebraska, 1959

Adviser: John Hall Lonnquist

The fertility differences, the effect of selection for fertility and the relation of cytological observations to fertility in several artificially-induced autotetraploid barley varieties (*Hordeum vulgare* L.) and their hybrids were determined in a study conducted from 1952 to 1958.

Most of the autotetraploids were obtained by soaking germinated diploid seed in a 0.1 percent colchicine solution. Selection for induced autotetraploid plants was done by visual observation in the C_2 generation. The varieties and hybrids tested varied greatly in mean percent fertility and each had a wide fertility range. It was possible to increase the mean percent fertility of the C_4 generation by selection within the progenies of the C_3 generation of autotetraploid hybrids, but it was not possible to increase the fertility of autotetraploid barley varieties by similar selection. All induced autotetraploids were true-breeding.

Fertility studies of several artificially-induced autotetraploid barley varieties showed that two-row autotetraploids were more fertile than six-row types. In all cases the fertility was lower than that obtained in the diploid varieties.

The chromosomes at metaphase I were associated mainly as bivalents and quadrivalents. The mean number of quadrivalents was 2, with a range of 0 to 7 per cell.

Anaphase I studies showed that approximately 50 percent of the cells and the normal 14-14 chromosome distribution, 20 percent had 13-15 and the remainder had from 1 to 6 lagging chromosomes.

A study of quartets showed that many had micronuclei present. A study of embryo sacs from sterile and fertile tetraploid florets indicated that embryo sacs of sterile florets developed normally but fertilization did not take place. There was no apparent difference between varieties or hybrids in the meiotic observations made.

The differences in fertility found between autotetraploid hybrids and varieties could not be explained by the meiotic irregularities observed. It was concluded, therefore, that genetically-controlled, physiological sterility, as suggested by other workers, is at least partly responsible for the lowered fertility in autotetraploid barley.

Microfilm \$2.00; Xerox \$5.20. 101 pages.

BOTANY

THE EFFECT OF BORON ON THE ELONGATION AND INTERNAL STRUCTURE OF TOMATO ROOT TIPS

(L. C. Card No. Mic 59-1807)

Luke S. Albert, Ph.D.
Rutgers University, 1959

Major Professor: Dr. Curtis M. Wilson

The effect of the level of boron nutrition on the elongation of intact and excised roots of Rutgers tomato plants was the main subject of this investigation. Internal boron deficiency symptoms in root tips from intact plants were studied with the light and electron microscope. All plants were grown in solution culture with an adequate supply of boron (0.1 ppm) until measurements of root elongation were started, at which time the level of boron nutrition was changed according to the requirements of each experiment. Excised root tips were grown in sterile culture in White's medium.

Root elongation of intact plants grown in solution culture with an adequate supply of boron (0.1 ppm) was significantly correlated (1% level): (a) directly with the sum of the solar radiation for the two days over which the experimental period of 24 hours extended, and (b) inversely with the height of the plant at the time the experiment was started. Root elongation of intact plants responded to changes in the nutrient concentration of boron as low as 0.001 ppm.

Boron deficiency symptoms of roots were detected within 24 hours after boron was withheld from the nutrient solution. These symptoms consisted of (a) the stopping of root elongation 6 to 12 hours after boron was withheld, and (b) the development of a brown color in the terminal portion of the root tip. When boron was withheld for 24 hours the dominance of the main root tip was reduced, and when boron was again supplied the laterals began to elongate.

Boron supplied in the nutrient solution to one portion of a split root system did not support growth by elongation of the root tips on the portion of the root system that did not receive a supply of boron.

Excised root tips grown in sterile culture in White's medium for 17 days, without an added supply of boron, did not show the same striking inhibition of root elongation that was exhibited by root tips of intact plants 24 hours after the boron was withheld from the nutrient solution. Neither White's solution or any of its components relieved the inhibition of root elongation of intact plants caused by the absence of boron from the nutrient solution.

Root elongation of intact plants during 24 hours in which boron was withheld from the nutrient solution was significantly (1% level), and negatively correlated with the solar radiation of the day the experiment was started.

It is suggested that some factor, present in the top of the plant, different from carbohydrate, and affected by light, may influence the response of tomato plants to a

deficiency of boron. This suggestion is based on: (a) the high positive (direct) correlation between solar radiation and root elongation in the presence of boron, and on the high negative (inverse) correlation between solar radiation and root elongation in the absence of boron, and (b) on the difference between the response of excised roots and the response of roots of intact plants to the absence of boron from the nutrient solution.

The first internal symptoms of boron deficiency in root tips developed within 24 hours after boron was withheld, and were evident in the first millimeter of the post-meristematic region of the tip. The first symptoms appeared to be a disintegration of the protoplasts of some of the cortical cells. Electron micrographs of thin sections of root tips from plants grown for two weeks at a low level of boron (0.001 ppm), showed what appeared to be stages of nuclear disintegration. In some of these sections there also appeared to be cell wall breakdown.

Microfilm \$2.00; Xerox \$6.00. 123 pages.

A STUDY OF PSEUDO-NANISM IN PINUS RIGIDA MILL.

(L. C. Card No. Mic 59-1808)

John W. Andresen, Ph.D.
Rutgers University, 1959

Major Professor: Murray F. Buell

Of the many factors supposedly responsible for the nanism of Pinus rigida growing in areas known as the Pine Plains of Burlington and Ocean Counties, New Jersey, frequent fires or toxic quantities of soluble aluminum have been proposed as of major importance. A study of the vegetation and the chemical and physical properties of 144 soil wells dug in the Plains and surrounding Pine Barrens areas supporting trees 30 to 40 feet tall revealed no relationship between soluble aluminum and the dwarf pines. The coppice growth of the pines is caused by sprouting after frequent and destructive fires.

Three years after planting, survival rates of 400 Pinus rigida trees were 63.5 per cent on a Barrens site and 89 per cent on a Plains site even though there was five times as much soluble aluminum (200 p.p.m.) in the rooting zone of the latter soil. The lower survival rate and corresponding poor growth rates were attributed to a lack of water retaining soil colloids.

The most vigorous and best formed collar-sprouts of 25 freshly cut Pinus rigida stumps ranging in age from 4 to 95 years were produced on tree stumps 8 to 11 years old. Even though one stump 32 years old produced 330 living sprouts, this number decreased to 195 a year later and finally fell to zero when the sprouts were severely browsed.

Soluble aluminum (between 40 and 500+ p.p.m.) in the B horizons of 12 Plains and 12 Barrens soils brought indoors caused no consistent growth depression in either *Pinus rigida* or *Avena sativa*. Varying growth reactions of these two species when grown in the same soil indicated that one is not a reliable phytometer of the other. Fertilizer and lime amendments to two Plains and two Barrens soils in a greenhouse test produced similar results within treatments when *Avena sativa* was grown in them.

Microfilm \$2.00; Xerox \$5.60. 112 pages.

ANATOMICAL AND RESPIRATION STUDIES
OF THE ASPARAGUS STEM AND
THE DEVELOPMENT OF FIBROUSNESS
DURING STORAGE

(L. C. Card No. Mic 59-1890)

James Robert Brennan, Ph.D.
University of Maryland, 1958

Supervisor: Dr. Robert D. Rappleye

Spears of *Asparagus officinalis* L. var. *altilis* L. Hort. var. Mary Washington were collected from the same plot at the University of Maryland Plant Research Farm during the 1956 and 1957 seasons. These spears were used as experimental material for the following purposes: (1) the determination of the "fiber"* constitution (as measured by the Waring blender method); (2) the instrumentation of a non-destructive pressure gauge for "fiber" determination; (3) the microscopic analysis of factors associated with variations in resistance-to-cut; (4) the determination of what effects various storage conditions had on "fiber" development, as measured by resistance-to-cut and by microscopic analysis; and (5) the determination of what effects various storage conditions had on elongation and respiratory rate.

It was found that the bulk of the material classified as "fiber" in the blender method of analysis consisted primarily of cellular fragments from the pericyclic fiber ring and tracheary element fragments. The more mature spears have higher "fiber" percentages due to the fact that there are a larger number of resistant cells with thicker walls. Microscopic examinations of cross-sections made adjacent to the points of resistance-to-cut determinations revealed that these same factors were associated with variations in pressure readings.

Storage experiments under various conditions were conducted with spears selected at random from the field and graded by conventional size criteria. However, these criteria proved to be invalid developmentally, and no statistically significant differences induced by post-harvest storage conditions were detected. To alleviate the variability of experimental material, tests were conducted subsequently using spears split longitudinally. With this material it was possible to place halves of the same spear under different storage conditions. Spears stored with the cut ends immersed in water were observed to have elongated more than those stored with the cut ends dry. In two experiments a more mature degree of cellular development in the pericyclic fiber ring was observed for spears stored with the cut ends dry as compared to spears

stored with the cut ends in water. In both experiments microscopic examinations were made five inches from the tips of the spears. In another experiment higher values for percentage of thick-walled tracheary elements per bundle in spears stored with the cut ends dry as compared to those stored with cut ends in water were also noted. In this case examinations were made one-half inch above the original ground lines. These data indicate that there may be a slightly larger number of thick-walled cells in spears stored dry as compared to those stored wet. However, if "fiber" analyses are made at a specific distance from spear tips, as has been done in past work, it is possible that lower amounts of "fiber" will be found for spears that elongated during storage than for those in which elongation was retarded. It was found that more carbon dioxide was evolved and more oxygen taken up by the spears stored with their cut ends exposed to the atmosphere than by those stored in water. It appeared that in most cases the retardation of respiration caused by immersion of a portion of the spears in water would be sufficient to account for the observed differences. Therefore it seems that the respiratory rate of spears stored with the cut ends dry is not markedly different from that of spears stored with the cut ends in water.

Microfilm \$2.00; Xerox \$4.40. 82 pages.

*The term "fiber" as it appears in quotation marks refers to the total amount of cellular material contributing to the fibrous condition, while the term used without quotation marks refers to a specific cell type.

HAPLOID PARTHENOGENESIS IN
CAPSICUM FRUTESCENS L. FOLLOWING
CROSSES WITH UNTREATED AND
X-RAYED POLLEN

(L. C. Card No. Mic 59-1893)

Filomena Fortich Campos, Ph.D.
University of Maryland, 1958

Supervisor: Dr. Delbert T. Morgan, Jr.

Two autodiploid lines of *Capsicum frutescens* L., derived from colchicine treatment of haploid sporophytes, were utilized as female parents and crossed with untreated and X-rayed pollen of the variety Floral Gem. One of the autodiploid lines, G168A, was characterized by an unusually high frequency of multiple seedlings with haploid members; the other autodiploid, P1A, produced few multiple seedlings with no haploid members. The male parent, Floral Gem, had a low frequency of multiple seedlings and differed from the autodiploids in inherited fruit characters, which permitted identification of the resulting multiple seedlings and haploids as to origin. The F_1 and X_1 populations from these crosses were studied to determine the genotypic control of the types, frequencies and origin of multiple seedlings and to determine if haploid sporophytes arose from monoembryonic as well as polyembryonic seeds of this species.

G168A, characterized by a high frequency of haploid-diploid twins following self-pollination, maintained this attribute following cross-pollination with Floral Gem.

Cytogenetic alteration of the pollen by X-ray dosages of 500r, 1000r, and 2000r did not significantly alter the frequency and type of multiple seedlings. Similarly, X-irradiation of the pollen of Floral Gem did not significantly alter the type and frequency of multiple seedlings produced when P1A was utilized as the female parent. These results support the conclusion that the genotype of the female parent is the primary factor in determining the types and frequencies of multiple seedlings in this species. The genotype of G168A thus, in some manner, greatly increases the frequency of maternal haploid parthenogenesis resulting in maternal haploid-sexual diploid twin seedlings.

Since monoembryonic haploids have not been reported previously for this species, individual seedlings were classified for haploids. The primary screening technique was based on shedding of pollen; sterile plants were isolated and haploids subsequently determined by chromosome counts from root-tips or microsporocytes. Seventeen monoembryonic haploids were found among the X_1 populations of G168A x Floral Gem following crosses with pollen subjected to 1000r or 2000r. All but one of the haploids produced fruits which enabled them to be classified as maternal in origin. The frequencies of haploid parthenogenesis following the pollen treatments of 1000r and 2000r were not significantly different. Only one haploid, paternal in origin, was detected in the progeny of autodiploid P1A x Floral Gem. The single haploid occurred in the F_1 ; none was found in the X_1 populations.

These results show that the genotype of the female parent is of prime significance in regard to haploid parthenogenesis in this species and that the genotype of the female parent must be considered in experiments designed to induce haploid parthenogenesis.

Microfilm \$2.00; Xerox \$3.00. 45 pages.

STUDIES ON HOST RANGE, BIOASSAY AND PROPERTIES OF TURNIP MOSAIC VIRUS (MARMOR BRASSICAE H.) FROM HORSE RADISH

(L. C. Card No. Mic 59-2013)

Vedula Venkata Chenulu, Ph.D.
University of Illinois, 1959

The studies were made on an isolate of the virus obtained from a single necrotic local lesion on a leaf of *Nicotiana tabacum* L., which had been inoculated with an extract from leaves of a clone of commercial horseradish. The virus was maintained and increased in *Nicotiana glutinosa*, and was assayed on *Chenopodium amaranticolor* except in a comparison of this plant and *Nicotiana tabacum* L., Turkish, as local lesion assay plants. Although the two assay plants were about equally sensitive to the virus, *Chenopodium amaranticolor* was chosen for the assays because it had such advantages as shorter incubation period of infection, and less variation in the amount of infection due to fluctuations in greenhouse temperature.

Thirty five species of plants were tested for their reaction to infection. Those without observable symptoms and assayable virus were *Chenopodium Bonus-Henricus* L., *Cucurbita maxima* Duchesne, *Cucumis sativus* L., *Cyamopsis tetragonaloba* Taub., *Datura arborea* L., *Datura stramonium* L., *Dolichos Lablab* L., *Dolichos sesquipedalis*

L., *Ipomea purpurea* Roth., *Matthiola incana* R. Br., *Phaseolus vulgaris* L., *Physalis alkekengi* L., *Physalis pruinosa* L., *Raphanus sativus* L., *Solanum aculeatissimum* Jacq., *Solanum carolinense* L., *Solanum marginatum* L., *Solanum verbascifolium* L., *Vicia Faba* L., and *Vigna sinensis* Endl., those with observable local lesion symptoms were *Chenopodium album* L., *Chenopodium amaranticolor* Coste. & Reyn., *Chenopodium Botrys* L., *Datura quercifolia* H. B. & K., *Gomphrena globosa* L., *Helianthus annuus* L., *Nicotiana tabacum* L., *Solanum aviculare* Forst., and *Solanum nigrum* L., those with observable systemic symptoms were *Brassica juncea* Coss., *Brassica oleracea* L. var. *capitata* L., *Brassica oleracea* L. var. *Botrytis* L., *Brassica Rapa* L., *Datura innoxia* Mill., *Datura quercifolia* H. B. & K., *Nicotiana glutinosa* L., *Solanum aviculare* Forst., and *Zinnia elegans* Jacq. There were none with unobservable symptoms and assayable virus. *Nicotiana glutinosa* had the highest titre of virus in extracts.

In a search for virus-free clones of horseradish, extracts from five accessions assayed negatively on *Chenopodium amaranticolor*, whereas, sixty seven accessions assayed varying amounts of virus.

For the assay of virus on *Chenopodium amaranticolor*, the greatest number of local lesions occurred when the inoculum contained a H-ion concentration of pH 8.0 and a phosphate buffer salt concentration of 0.2 M. Post inoculation temperature either 30.5°C or 18.0°C did not affect the amount of infection, but low temperature (18°C) prolonged the incubation period.

Some properties of the virus in extracts from *Nicotiana glutinosa* were ascertained. The longevity in vitro at room temperature (24°C) is 11 days. Extracts were non-infectious at dilutions of 1:1000 and greater. The virus in standard extract (pH 7.0) is inactivated at 55°C for 10 minutes, and at 50°C for two hours. The virus is infective even after two hours of heating at 45°C. The thermal inactivation of the virus is more rapid in an alkaline medium than in an acid or neutral medium. At room temperature (24°C) the virus is most stable in solutions having no buffer salt or in solutions having 0.2 to 1.0 M concentration of buffer salt, but is inactivated in one hour at pH 9.5 and pH 10.0, and instantly at pH 4.0. When exposed for six hours at varied pH, least inactivation occurred at pH 8.0. The virus withstands continuous freezing (-40°C) as long as 45 days, but is inactivated quickly when subjected to alternate freezings and thawings. Filterability, although less than 5 per cent, was achieved at pH 8.5 and 9.0 through Mandler (normal porosity) and Seitz filters, but only at pH 9.0 through Celite cakes.

Microfilm \$2.00; Xerox \$3.00. 55 pages.

THE INORGANIC NUTRITION OF LOBLOLLY PINE (*PINUS TAEDA* L.) AND VIRGINIA PINE (*P. VIRGINIANA* MILL.) WITH SPECIAL REFERENCE TO NITROGEN AND PHOSPHORUS

(L. C. Card No. Mic 59-1900)

Harry Ardell Fowells, Ph.D.
University of Maryland, 1958

Supervisor: Associate Professor Robert W. Krauss

This study determined the response of loblolly pine (*Pinus taeda* L.) and of Virginia pine (*P. virginiana* Mill.) to various amounts of nitrogen and phosphorus. Year-old seedlings of these pines were planted and grown in sand culture for nearly a year and supplied by automatic irrigation with nitrogen and with phosphorus at the rates of 1, 5, 25, 100, 200, and 400 ppm. In a supplementary experiment phosphorus concentrations of 0, 0.1, and 0.5 ppm were included also. Other essential macro- and micro-nutrients were supplied at a constant level. Foliage samples of these two pines were obtained from a number of localities to provide a comparison of the foliar composition of forest trees with those grown under controlled conditions.

Needles, stems, and roots of the harvested trees were dried at 70°C, and weighed. The amounts of nitrogen and phosphorus in samples of these fractions and the field samples of needles were determined. In addition the amounts of potassium, sodium, and calcium were determined for the foliage of the trees grown in culture.

A nitrogen level of 25 ppm and a phosphorus level of 1 ppm in the culture solution resulted in growth of loblolly and Virginia pine equal to, or better than, growth in other treatments. Trees with 1 and 5 ppm nitrogen and 0 and 0.1 ppm phosphorus showed deficiency symptoms, characterized by short, stiff, yellowish-green needles in the nitrogen deficient trees, and by early abscission of the needles in the phosphorus deficient trees. Trees given nitrogen at the rate of 1 ppm nitrogen and 1 ppm phosphorus or less maintained mycorrhizae on the root systems. Root hairs instead of mycorrhizae were observed on the roots of the trees given greater amounts of these elements.

The nitrogen concentration in the needles of the trees making best growth was 1.7 to 2.3 percent and the phosphorus concentration was 0.14 to 0.16 percent. In trees deficient in nitrogen and in phosphorus the concentration of nitrogen and of phosphorus in the foliage was 1.2 percent and 0.10 percent, respectively, or less.

Significant differences were found among the nitrogen and phosphorus concentrations of needles collected from various forest locations. Samples from some locations indicated deficiencies of nitrogen or phosphorus or both. A significant correlation was found between site index of the sample locations and phosphorus concentration of the needles.

The study provides a basis for additional controlled experimentation on the inorganic nutrition of loblolly, Virginia, and other pines.

Microfilm \$2.00; Xerox \$4.20. 80 pages.

MECHANISMS OF ACTION OF POLYMYXIN B ON *CHLORELLA* AND *SCENEDESMUS*

(L. C. Card No. Mic 59-1903)

Raymond Alfred Galloway, Ph.D.
University of Maryland, 1958

Supervisor: Dr. Robert W. Krauss

An investigation was made of the mode of action of polymyxin B with regard to three species of unicellular green algae, *Chlorella pyrenoidosa* Chick, Van Niel's strain, *Chlorella vulgaris* Beijerinck, Pringsheim's strain, isolated by Emerson, and *Scenedesmus obliquus* Turp. (Kutz), strain WH-50, isolated by Krauss. *C. pyrenoidosa* is inhibited by 5 to 10 ppm of polymyxin B, whereas *C. vulgaris* and *S. obliquus* are unaffected. Previous work showed that certain susceptible bacteria are protected from inhibition by the presence of galactose. Consequently this research was oriented toward a study of the metabolism of hexoses in the three algae, especially with regard to the protective effect of galactose on susceptible algae, as well as the mechanism of resistance in normally resistant algae. An hypothesis compatible with the evidence of galactose protection was that the site of polymyxin inhibition was one of the enzyme systems involved in the first several reaction of glycolysis. Thus the utilization of galactose appeared to involve a "by-way" to the classical Embden-Meyerhof sequence. An examination of the effect of polymyxin B on extracted phosphoglucose isomerase revealed an inhibition of the competitive type. A block at this site established that convergence of the galactose "by-way" with glycolysis must occur at the level of fructose-6-phosphate or beyond. The phosphate esters synthesized by the resistant species of algae, *Chlorella vulgaris* and *Scenedesmus obliquus* were found to include galactose-6-phosphate, an ester not previously identified in the Embden-Meyerhof scheme. It could conceivably arise either by mutation of galactose-1-phosphate to galactose-6-phosphate under the influence of a phosphogalactomutase, or by the direct phosphorylation of galactose on carbon six by a galactokinase. One of three subsequent transformations must occur: (1) tagatose-6-phosphate could be converted to fructose-6-phosphate by means of a phosphotagatose epimerase; (2) the diphosphate ester of tagatose could be converted to fructose-1,6-diphosphate under the influence of a diphosphotagatoisomerase; or, (3) tagatose-1,6-diphosphate itself could be split by means of an aldolase to yield the two triose esters. No evidence yet exists which enables a choice among these three possibilities of re-entry into the classical glycolytic pathway.

The ability to circumvent a block in the glycolytic pathway in the manner suggested accounts for the protection afforded by galactose in the case of certain otherwise susceptible organisms incapable of obtaining energy from glucose via galactose. This also accounts for the synthesis of galactose-6-phosphate in resistant organisms.

A capacity of polymyxin B which has been previously established is its ability to disorganize cellular membranes. This results in a disruption of the osmotic processes and consequently a loss of cellular components. This investigation showed that the leakage of phosphorous from cells of the susceptible alga, *Chlorella pyrenoidosa*, is approximately 80% after 15 minutes exposure to the antibiotic.

Resistance to polymyxin B requires first a membrane which withstands attack, and, second, a sequence of enzymatic reactions capable of yielding energy to the organisms in the absence of phosphoglucose isomerase.

Microfilm \$2.00; Xerox \$3.80. 67 pages.

STUDIES OF THE INITIAL INFECTION PROCESSES BY CERTAIN MECHANICALLY TRANSMITTED PLANT VIRUSES AND THEIR HOSTS

(L. C. Card No. Mic 59-1785)

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Adviser: William B. Allington

The receptivity of wounded leaves of *Nicotiana glauca* Spegaz and Comes, and *Phaseolus vulgaris* Linn. var. *Scotia* to tobacco necrosis virus (TNV), common tobacco mosaic virus (CTMV), and the yellow strain of common tobacco mosaic virus (YTMV) under different experimental conditions was studied as an indirect approach in the elucidation of the processes involved in the establishment of virus infection in plants prior to virus multiplication.

Wounding of low intensity under specified experimental conditions produced a uniformly low level of infection. It minimized the possibility that developing lesions might fuse as would be anticipated under high levels of infection and thus it greatly reduced the error in determining the number of infection points. Furthermore, it was demonstrated that all receptive sites of the host may be saturated with the virus when its concentration in the inoculum reaches a certain level.

Significant decrease in receptivity to YTMV occurred when the inoculation was delayed for one minute or more after wounding of *N. glauca*. The level of infection for TNV with the same host, however, was very low in the first few seconds, then increased significantly up to five minutes after mild wounding and subsequently remained at the high level without any significant drop for the duration of the test. Similar results were obtained with *P. vulgaris* and TNV. When CTMV was used in the above host, no significant changes in a rather low level of receptivity were observed at the time intervals tested.

Certain specific relationships were disclosed when the above hosts, exhibiting two radically different optima of receptivity after wounding, were inoculated with CTMV, YTMV, and TNV in different combinations and at two different optimal time intervals after mild wounding. Phosphate buffer reduced significantly the receptivity of the hosts. The receptivity of *N. glauca* to YTMV ten minutes after wounding was significantly reduced by CTMV when the latter was introduced as fast as possible after wounding. The effect of CTMV on the level of infection with TNV under similar conditions, however, was only within the range of phosphate buffer effect which served as a check. A similar relationship was disclosed in the case of YTMV, TNV, and *P. vulgaris* system. There was no significant difference between the levels of infection in *P. vulgaris* when CTMV was introduced alone immediately after wounding and when this primary inoculum was followed ten minutes later by TNV which gave appreciable

amounts of infection. Similar trends in preferential receptivity of the hosts to the specific viruses were observed with the change of time interval after wounding when the inoculum consisted of a mixture of the respective viruses in the same concentrations.

The results strongly indicate a differential and specific nature of the host's receptive sites which appear most active at different time intervals after wounding. The nature and the location of these sites appears to be different for each virus system studied. Consequently, a successful establishment of infection is not a function of the infectivity of the virus preparation alone but it also depends upon the intrinsic reaction of the host. These observations are compatible with the theories that there are specific optimal conditions necessary for the successful establishment of a given plant virus and the host, as previously demonstrated for certain animal and bacterial host-virus systems. The results are not consistent with the theories which advocate the entry of virus particles *per se* into the slightly wounded cell as being sufficient for the infection.

Microfilm \$2.00; Xerox \$3.00. 57 pages.

TOXINS ASSOCIATED WITH HELMINTHOSPORIUM BLIGHT OF OATS

(L. C. Card No. Mic 59-1535)

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Louisiana State University, 1959

Supervisor: Professor H. E. Wheeler

An attempt was made to isolate a toxin from Victor-grain oats infected with *Helminthosporium victoriae* which would be similar to the *in vitro* toxin "victorin" produced by the fungus.

Three toxins, detected by their inhibition of root growth of Victorgrain and Camellia seedlings, were recovered from plant extracts. A nonspecific toxin was present in healthy plant extracts and two additional toxins, one specific and one nonspecific, were recovered from diseased plant extracts. The toxin of healthy plant extracts was consistently recovered, whereas the other two toxins could not be recovered during the summer and early fall months. The specific toxin was similar to victorin. It was heat stable at 78° C when acid; it could be adsorbed on charcoal; it was specific for Victorgrain and its toxicity was manifested by its inhibition of root growth.

A total of 3,600 Victorgrain and 3,450 Arlington seedlings were screened with victorin in an attempt to obtain seedlings which would show intermediate reactions to *Helminthosporium* blight. Thirty-seven Victorgrain and 100 Arlington seedlings survived the treatment with an intermediate type of reaction. These selections showed varying reactions to crown rust and most of the selections were susceptible. Grain from the intermediate selections and from the next generation were treated further with victorin. Only two of the Arlington seedlings continued to show an intermediate reaction to victorin. It is possible that a complex locus controls reactions to crown rust and *H. victoriae*. Microfilm \$2.00; Xerox \$3.60. 65 pages.

ANTIBIOSIS OF *CLOSTRIDIUM BUTYRICUM*
 PRAZMOWSKI ON *TYLENCHORHYNCHUS*
 MARTINI FIELDING, 1956, (NEMATODA, PHASMIDIA)
 IN SUBMERGED RICE SOIL

(L. C. Card No. Mic 59-1536)

Titus Meredith Johnston, Ph.D.
 Louisiana State University, 1959

Supervisor: Professor John P. Hollis

Populations of the stylet nematode (*Tylenchorhynchus martini* Fielding, 1956, Nematoda, Phasmodia) in submerged Crowley silt loam soil were markedly reduced by microbial activity. Combined laboratory data from soil and pure culture studies indicated that the primary effect reducing populations of the nematode in submerged soil stemmed from increased numbers and enhanced antibiotic activity of *Clostridium butyricum* Prazmowski and was not due to a lack of oxygen. The nematode survived at prolonged periods (18 days) in a nitrogen atmosphere *in vitro*.

Relations between *C. butyricum* and *T. martini* were studied in culture fluids and in Crowley silt loam soil supplemented with cornmeal and sucrose. There was no evidence of a parasitic relationship. Nematodes were always free internally of bacteria, regardless of their physiological condition. *C. butyricum* produced substances antibiotic to the nematode. Survival of *T. martini* in submerged Crowley silt loam soil was related inversely to the numbers of *C. butyricum* and was markedly depressed by supplements of cornmeal or sucrose to soil containing *C. butyricum*.

Metabolic products produced in artificial culture of *C. butyricum* were extracted and separated by steam distillation and partition chromatography. Only the volatile fatty acids (butyric, propionic, acetic and formic) were active against *T. martini*. Although nematode response was variable, individual acids at those concentrations extracted from artificial culture required at least 12 hours to inactivate *T. martini* in water solutions. However, mixtures of such acids containing butyric acid were more effective against *T. martini* in water solutions and soil cultures. Mixtures of acids containing butyric acid, of combined molarity equal to butyric acid alone, were more effective than butyric acid alone. Effectiveness of acids in mixtures in most cases was related also to molecular weights of the individual acid combinations. The butyric and propionic acid combinations, for example, were more effective than butyric and formic acid combinations.

The basis for the enhanced activity of mixtures of fatty acids against *T. martini* was undetermined; however such mixtures may be of importance in the biological control of nematodes in submerged rice soil. The control of nematodes by *C. butyricum* and its response to supplements of cornmeal and sucrose indicate that this bacterium shares a common dependence for increased activity upon soil organic matter with certain types of fungal parasites active against nematodes.

Microfilm \$2.00; Xerox \$4.00. 74 pages.

PHOTOPERIODIC REACTIONS OF CERTAIN
 HERBACEOUS PERENNIALS UNDER
 CONTROLLED TEMPERATURE CONDITIONS

(L. C. Card No. Mic 59-2297)

William Joseph MacMasters, Ph.D.
 The Ohio State University, 1953

Introduction

The original technique of testing plants for their photoperiodic reactions as used by Garner and Allard¹ has since been modified in many ways by numerous investigators. By various procedures (Hamner² and others), the effects of induction cycles on the photoperiodic reactions of plants have been studied. Investigations on the photoperiodic reactions of plants to light of various wave lengths have been carried out by numerous investigators, the most recent having been by Borthwick, et al.³ Other investigators have studied these reactions in relation to light intensity and kind of light source employed, such as incandescent, carbon arc, and fluorescent lamps.

The modifying effects of temperature on photoperiodism have been known ever since early observations by Garner and Allard⁴ in 1923. More recently, the relation of temperature, either during the dark or light periods, or both, to length of day effects has been studied by Roberts and Struckmeyer,⁵ Parker and Borthwick,⁶ and Lewis and Went.⁷

Vernalization experiments have been carried out with different cereals and the effects extensively studied by Purvis.⁸ The term "vernalization" is usually used to designate a low temperature (usually just above freezing) treatment given slightly germinated seeds before sowing which shortens the time to flowering of plants which develop from them. This effect is clearly one on the flowering mechanism of plants.

Thermal induction (low temperature) experiments have been conducted with various species. For example, Coville⁹ studied the effects of different lengths of chilling periods on the subsequent vegetative and reproductive development of various deciduous perennial plants. Stout¹⁰ studied the effects of cool temperature exposure on the subsequent reproductive development of the sugar beet. And, most recently, Olmsted¹¹ has studied such effects on the vegetative development of sugar maple.

With only a few exceptions all investigations dealing with photoperiodism and thermoperiodism, and thermal induction (low temperature) effects, have been carried out with annual and biennial species. Very little work has been done with herbaceous perennial species. The purpose of this investigation was to study the photoperiodic behavior of several herbaceous perennial species under controlled temperature cycles and after different periods of pre-chilling treatment.

Experimental Methods

For this investigation facilities for artificial illumination were installed in two controlled temperature rooms. The cooling and air circulation for each room were accomplished by direct expansion coils of a blower unit with a 17-inch fan. Each Freon compressor had a capacity commensurate with the radiation load during the peak hours of the day. The cooling of the compressors was

accomplished by reverse flow water coolers. This permitted short time changes in temperature. The lighting facilities for each room were controlled by a time switch, and the cooling system was regulated by a chronotherm. Thus a regular alternation between day and night temperatures could be synchronized with shifts from light to dark periods. Supplementary heat during the dark period in the coldest months of the year was supplied by the use of electric heaters controlled by bimetal thermoregulators. The exchange of air between the rooms and the external atmosphere was facilitated by the use of louvers to the outdoor atmosphere.

A group of twelve 4500⁰ standard cool-white, slimline, fluorescent lamps 8 feet long was mounted on each of six steel frames. The lamps were as closely spaced as the standard fittings would permit. Three such light banks were installed in each room. The ballasts were installed in the attic above the rooms to avoid heat release. Four rows of nine 60-watt, incandescent lamps each were mounted on the sides of two of the banks so that each group of twelve fluorescent lamps alternated with a row of incandescent filament lamps. This arrangement was designed to supplement light in the far red end of the spectrum, in which the fluorescent lamps were deficient.

Each independent light bank was suspended by a pulley and cable system. Cable clamps were set 8 in. apart on the cables so that when the light banks were raised or lowered 8 in., the light intensity was decreased or increased approximately 100 foot-candles. The lamp travel was 7 ft. and the light intensity at 1 ft. was 1900 foot-candles, and 1000 foot-candles at 6 ft. Maximum distribution of reflected light was obtained by painting the interior walls of each room and all equipment white.

The plants were maintained within the 6 by 8 ft. area, underneath the light banks. At the beginning of the investigation the banks were suspended 4.5 feet above the pots. The light intensity at pot level was in the range of 1000 to 1200 foot-candles. This intensity was maintained throughout the experiments midway between the bases and tops of the plants. Thus all of the plants except *Valeriana*, which grows in a rosette form when vegetative, were subjected to this light intensity throughout their growth. *Valeriana* plants were exposed to a slightly lower intensity.

The species selected for study and the month when each flowered in central Ohio in 1952 were as follows: *Valeriana pauciflora* Michx., May; *Veronicastrum virginicum* L. Farw., July; *Eupatorium coelestinum* L., August; and *Aster cordifolius* L., September. These species were selected because they are all herbaceous perennials, often grow in nature under at least moderate shade, and flower in nature at different seasons ranging from mid-spring to early fall. Two of these species exhibit one type of growth habit, the other two another type of growth habit. *Aster* and *Valeriana* may be classed as "wintergreens," persisting through the winter months in the form of rosettes. *Eupatorium* and *Veronicastrum*, on the other hand, are perennial by persistence of underground parts during the winter.

Eighty plants each of *Valeriana*, *Eupatorium*, and *Aster* were obtained by digging up their root systems in late October 1951 in a woodland within the city limits of Columbus. *Veronicastrum* roots were obtained commercially from Ashford, N. C. The root systems were planted in 4-in. pots, the soil medium being equal proportions of clay loam, sand, and peat moss. On Nov. 1, 1951, the plants of

each species were divided into four groups of twenty each. Three of the groups were transferred to a refrigeration room maintained at a temperature of $34 \pm 1^{\circ}$ F. and subjected to this temperature for 30, 60, and 90 days respectively. The fourth group was not cold-treated. The non-cold-treated group was further divided into two sets of ten plants each. One set was maintained at a 9-hr. photoperiod, while the second set was maintained at a 15-hr. photoperiod. In both rooms the photoperiod temperature was maintained at 75 to 76⁰ F. and the dark period temperature was maintained at 60 to 61⁰ F. After a period of 90 days two reversal series each were made with the *Valeriana* and *Eupatorium* groups of plants. Half of each 9-hr. photoperiod set of plants was transferred to the 15-hr. photoperiod and half of each 15-hr. photoperiod set of plants was transferred to the 9-hr. photoperiod for an additional period of 23 to 181 days. The other half of each set was maintained at the 9- or 15-hr. photoperiod throughout the course of the investigation. *Veronicastrum* and *Aster* were subjected to the continuous photoperiods only. The same procedure was followed for the 30-day, 60-day, and 90-day cold-treated groups of plants as for the non-cold-treated group.

Results with Large-flowered Valerian (*Valeriana pauciflora* Michx.)

Since some growth of the non-cold-treated *Valeriana* plants occurred at both photoperiods, it appears that a cold treatment is not an absolute requirement for the vegetative development of *Valeriana*. However, the greater the length of the preceding cold treatment, the better the subsequent vegetative development of the rosettes. For each cold treatment, vegetative growth was more vigorous at the 15- than at the 9-hr. photoperiod.

No flowering occurred in the *Valeriana* plants that were not subjected to a pre-chilling period and no inflorescences developed on the plants in any set of the reversal series. Some sparse flowering occurred, however, at both 9- and 15-hr. photoperiods following the cold treatments. In view of the season of the year at which *Valeriana* flowers in nature, it appears probable that either the dark or light period temperature or the whole temperature cycle used in these experiments was too high for initiation and development of inflorescences to occur on a large percentage of *Valeriana* plants. In nature initiation of flowers in *Valeriana* occurs in April in central Ohio when the day and night temperatures are in the range of 60 to 70⁰ F. and 40 to 50⁰ F. respectively. Blooming occurs in May when the temperature cycle is usually somewhat higher.

The exact photoperiodic classification of *Valeriana* is not certain. In central Ohio, initiation of flowers in *Valeriana* occurs in April under a daily light period of 12 to 13 hours. From the results obtained in these experiments, there is a possibility that *Valeriana* may be an indeterminate plant. It could also be a long-day plant with a low critical photoperiod of 9 hours or less, or it could be a short-day plant with a high critical photoperiod of 15 hours or more. That it may be an intermediate plant is least likely.

Results with Culver's Root (*Veronicastrum virginicum* L. Farw.)

Since dormancy was not broken at either photoperiod in the non-cold-treated *Veronicastrum* plants, it appears

that a cold treatment is essential for the breaking of dormancy in this species in nature. Also, the greater the length of the preceding cold treatment, the better the subsequent vegetative development of the plants. For a given cold treatment, vegetative development was always more vigorous at the 15- than at the 9-hr. photoperiod as in *Valeriana*.

The longer the preceding cold treatment at the 15-hr. photoperiod, the greater the number of flowering plants in *Veronicastrum*. This effect was probably indirect through the better vegetative development of the plants. For each cold treatment the number of flowers was greater under the 15- than under the 9-hr. photoperiod. From the results obtained in this investigation, the temperature cycle used seems to have been a relatively favorable one for the vegetative and reproductive development of *Veronicastrum*.

Excellent blooming under continuous illumination occurred in this species. Under a 7-hr. photoperiod there was 20 per cent initiation of flowers but no blooming, and under an 8-hr. photoperiod there was 100 per cent initiation of flowers and 22 per cent blooming. There was 70 per cent initiation of flowers and 40 per cent blooming under the 9-hr. photoperiod, and 100 per cent initiation and 90 per cent blooming under the 15-hr. photoperiod. It appears from these results that *Veronicastrum* may be classed as an indeterminate plant with respect to initiation of flowers and a long-day plant with respect to blooming.

Results with Mist Flower (*Eupatorium coelestinum* L.)

As in *Valeriana*, a cold treatment is not an absolute requirement for the vegetative development of *Eupatorium*. However, there was an enhancing effect on the vegetative development when the cold treatments were followed by the 15-hr. photoperiod but not at the 9-hr. photoperiod. This may have resulted from the longer daily period of 75° F. temperature at the longer photoperiod.

Under the conditions used in this investigation, a few *Eupatorium* plants flowered at the 15-hr. photoperiod following some of the cold treatments while none flowered at the 9-hr. photoperiod or in any set of the reversal series. However, after all of the *Eupatorium* plants were transferred to the greenhouse in June, almost all of them were in full bloom by the end of August. From this result it appears probable that the temperature cycle in the rooms was too low for maximum flowering of this species.

Eupatorium is known to flower at summer greenhouse temperatures under a 10-hr. photoperiod but not under a 15-hr. photoperiod. In nature, flowering does not occur until August in central Ohio, when the natural day length has decreased to approximately 14 hours. In the controlled temperature rooms flowering occurred at the 15- but not at the 9-hr. photoperiod. At summer greenhouse temperatures the critical photoperiod is therefore below 15 hours and at or above 10 hours. Under natural conditions in August in central Ohio, at a somewhat lower temperature cycle, the critical photoperiod is not less than 14 hours. At the still lower temperature cycle used in this investigation the critical photoperiod is 15 hours or higher. Since the plants flowered under the 15-hr. photoperiod at the lowest temperature cycle, and did not flower under this photoperiod at the higher temperature cycles, this species is probably a short-day plant in which the critical

photoperiod becomes shorter as the daily temperature cycle rises.

Results with Heart-leaved Aster (*Aster cordifolius* L.)

Since stems elongated on some of the non-cold-treated *Aster* plants at the 15-hr. photoperiod, it is clear that a cold treatment is not an absolute requirement for the vegetative development of this species of aster beyond the rosette stage. However, a cold treatment had a favorable effect on stem development and, for each cold treatment used, was more effective if followed by a 15- than by a 9-hr. photoperiod. Also, stem elongation was more pronounced the longer the preceding cold treatment. This effect, for a given cold period, was always greater at the 15- than at the 9-hr. photoperiod. *Aster* plants resembling those which develop under favorable natural conditions developed only under the 15-hr. photoperiod. As with *Veronicastrum*, the temperature cycle used seems to have been a relatively favorable one for the vegetative and reproductive development of this species of *Aster*.

Most of the *Aster* plants flowered at the 15-hr. photoperiod in the non-treated and in all the cold-treated sets. However, considerable flowering occurred at the 9-hr. photoperiod only when the cold treatment was 60 or 90 days. The effect of the cold treatments on flowering was probably indirect through the effect on stem development. The plants that did not develop beyond the rosette stage at the various treatments did not flower. Under natural conditions in central Ohio *Aster cordifolius* is subjected to gradually increasing day lengths up to about 15 hours during its vegetative development in the spring and early summer, and initiation of flowers occurs in late summer during a period of gradually decreasing day lengths.

Since *Aster cordifolius* does not flower under continuous illumination and flowered under both 9- and 15-hr. photoperiods in this investigation, this species is probably a short-day plant with a rather high critical photoperiod (15 hours or more).

Microfilm \$2.00; Xerox \$4.40. 81 pages.

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QUANTITATIVE ANALYSIS OF LEAF DEVELOPMENT IN *XANTHIUM PENSYLVANICUM* WALLR.

(L. C. Card No. Mic 59-2252)

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University of Pennsylvania, 1959

Supervisor: Professor Ralph O. Erickson

In the present investigation of leaf development of *Xanthium pensylvanicum* Wallr., an attempt was made to find a quantitative way of describing the development of the leaf and to correlate the developmental processes, being able to designate precisely their sequence. The processes are presented in terms of the absolute and relative rates of leaf length, expansion of lamina in surface, increase in thickness, cell formation, and differentiation of three portions of the lamina. All rates were estimated over the entire period of growth, from initiation of a primordium to its maturity. The leaf plastochron index developed by Erickson and Michelini (1957) was used as a morphological time scale and the mean duration of one plastochron was 4.4 days. The relative rates were of special interest for the purpose of correlation of the developmental processes since they gave the percent values of any change and thus one coordinate system could be used for all activities.

It was estimated that leaf 9 of *Xanthium* elongates exponentially up to 3.0 plastochrons (L. P. I.), then the rate rapidly decreases and the growth stops around L. P. I. 8.0. The lamina stops elongating about 1.5 plastochrons before the petiole. The average relative rate of elongation ($d\ln L/dpl; pl^{-1}$) of the leaf, lamina and petiole is about 0.78 pl^{-1} during the exponential phase of growth.

The tip of the lamina expands its surface at a constantly lowest relative rate when compared with the middle and the basal portions of the blade. The average relative rate of expansion in area ($d\ln A/dpl; pl^{-1}$) for the whole lamina is 1.7 pl^{-1} during the exponential stage.

The morphogenetic studies did reveal that differentiation of the laminar tissue proceeds basipetally, from the tip toward the base of the leaf. At least four typical stages could be distinguished during the process of lamina differ-

entiation; from initiation of the lamina (L. P. I. -4.8) to L. P. I. 1.5 six basic, undifferentiated layers of cells; around L. P. I. 1.5 seven, eight or nine undifferentiated layers; from L. P. I. 2.0 to 4.0 rapid enlargement and differentiation of cells with formation of intercellular air spaces in the mesophyll tissue; and finally, after L. P. I. 4.2 a fully differentiated lamina.

Considering the rate of lamina expansion in thickness ($dT/dpl \cdot \mu \cdot pl^{-1}$) it was possible to estimate that at the six layer stage, a single cell will elongate in a plane perpendicular to the lamina surface at a rate of about 0.2 microns per day, and at L. P. I. 1.5 the same cell may elongate about 2.5 microns per day.

The formation of cells proceeds exponentially up to L. P. I. 3.0 and around this time cell division stops in all parts of the lamina. A mature leaf 9 has on the average 116 million cells and leaf 13, 156 million cells. A mature petiole of leaf 9 has 4.8 million cells and the petiole of leaf 13, 6.4 million cells. The mean relative rate of cell formation ($d\ln C/dpl; pl^{-1}$) at the exponential phase is 1.41 pl^{-1} , an increase of about 31 percent per day. From the exponential equation it was estimated that at least 27 generations of cells are involved in the process of leaf formation, and the generation time was calculated to be 0.5 plastochron or 2.2 days. This indicates that after approximately every second day the number of cells will double in the exponential phase of cell formation.

By means of correlation of the growth processes, the sequence of developmental events was established with some precision. At L. P. I. 3.0 cell divisions stop in all parts of the lamina. The mature thickness is reached at L. P. I. 4.2 and the expansion in area is completed at L. P. I. 6.5. The lamina stops elongating at least 1.5 plastochrons before the petiole, and around L. P. I. 8.0 a fully differentiated, mature leaf is formed.

Microfilm \$2.00; Xerox \$3.00. 40 pages.

THE SIGNIFICANCE OF THE AWNS OF DURUM WHEAT AS SUPPLIERS OF PHOTOSYNTHATE TO THE DEVELOPING KERNELS

(L. C. Card No. Mic 59-1919)

Walter Thomas McDonough, Ph.D.
University of Maryland, 1958

Supervisor: Dr. Hugh G. Gauch

The relative efficiencies of the awns and flag-leaf blade of Durum wheat as sources of photosynthate for the developing kernels was determined at normal and at deficient soil moisture levels. Photosynthesis and translocation were followed by the use of $^{14}CO_2$. Estimates of the contribution by the awns to total kernel dry weight were also obtained.

The awns were found to be more efficient suppliers of photosynthate to the kernels than the flag-leaf blade at all soil moisture levels, and particularly at levels close to the wilting percentage. It was estimated that photosynthesis in the awns was responsible for 12 per cent of the total kernel dry weight accumulated from the second through the fourth week after heading. The contribution was made largely to the starch fraction of the kernels.

Microfilm \$2.00; Xerox \$3.00. 45 pages.

THE VEGETATION OF THE
WILLIAM L. HUTCHESON MEMORIAL FOREST,
NEW JERSEY

(L. C. Card No. Mic 59-1821)

Carl D. Monk, Ph.D.
Rutgers University, 1959

Major Professor: Murray F. Buell

The William L. Hutcheson Memorial Forest, a 65-acre mature oak forest that has had a minimum of human influence, was divided into communities based on pattern of shrub distribution. A total of eight communities were recognized and sampled separately. The upland areas are dominated by white oak, black oak, red oak, and red hickory which form a 95-foot high canopy. Associated with these are white ash, red maple, sugar maple, Norway maple, and beech, the first two of which increase in importance in open areas. Beneath the almost closed canopy exists a pronounced understory of dogwood 35 feet in height. The shrub layer beneath is characterized by maple-leaved viburnum which gives way to black haw on open sites and to choke-cherry and black cherry in two small areas. The herb layer is dominated by May-apple in the spring and by enchanter's nightshade in late summer.

The poorly drained areas are divided into four communities dominated by different proportions of white oak, red oak, red maple, white ash, black gum, and pin oak. Within these areas, the canopy is more open due to more frequent wind damage. This more open canopy along with the absence of a continuous understory creates a condition favorable for a dense shrub layer. The poorly drained areas are dominated by either spicebush-arrowwood, arrowwood-greenbrier, swamp fetherbush, or poison ivy.

The dominant oaks contribute about 75% to total basal area. Considering this high dominance of the oaks, there is a surprising sparsity of small transgressives of these species. The important successful canopy transgressives are sugar maple and Norway maple, two species that have only a few established seed-trees in the woods at the present time. This leads to the conclusion that the shade tolerant maples are gaining in importance at the expense of the oaks.

This apparent shift seems to be in response to the cessation of fire and an increase in urbanization. The oaks apparently gained their high dominance in pre-colonial days when fire was prevalent. Under those conditions sugar maple could not exist. With the arrest of fire, conditions were made favorable for the maples that were brought into the area as lawn trees. These then served as the seed source for the maples in the forest.

Microfilm \$2.00; Xerox \$5.60. 113 pages.

SHOOT DEVELOPMENT IN DASYLIRION
LEIOPHYLLUM ENGELMANN

(L. C. Card No. Mic 59-2070)

James Marvin Moore, Ph.D.
The University of Oklahoma, 1959

Supervisor: Norman H. Boke

This dissertation concerns shoot development in *Dasy-lirion leiophyllum* Engelman with respect to (1) structure and development of the shoot apex (2) initiation and early development of the leaf and (3) structure and development of the primary and secondary thickening meristems.

In the embryo the shoot apex is only a small cluster of cells. In a seedling and a young adult it is asymmetrical, except near its base, appearing cone-like when viewed in the plane of the cotyledonary slit, but dome-like when viewed in a plane at right angles to the cotyledonary slit. In older plants the apex is symmetrical and appears in median longisection as a broad dome.

The five zones characteristic of the apical meristem are established by the time the emergent seedling is about 12 mm. long. These include (1) a 1-layered tunica, (2) a corpus, (3) a flank meristem, (4) a rib meristem and (5) a zone below the flank meristem and lateral to the rib meristem. As the apex increases in size, periclinal divisions in the outer corpus become fewer, resulting in the establishment of additional tunica layers. In the adult shoot apex these appear to vary from 6 to 7.

Leaf initiation begins with periclinal divisions deep in the flank meristem. Once the divisions have begun, they spread outwardly, occasionally reaching the first layer. These divisions result first in the formation of a leaf-buttress, but soon they spread laterally. A primordium then arises as a protuberance on the foliar buttress and in seedlings, gradually encircles the apex somewhat like a collar. The primordium then continues development by a combination of apical and marginal growth, while intercalary growth at its base continues elongation. Apical and marginal growth soon cease, but elongation continues by means of intercalary growth. Later, thickening of the leaf occurs by means of adaxial and abaxial meristems.

The primary thickening meristem originates when periclinal divisions occur in the derivatives of zone 5. It probably develops at lower levels when the sporadic periclinal divisions in the meristematic parenchyma surrounding the stele become continuous. As a result of divisions in the primary thickening meristem the upper part of the axis gradually expands upward and outward, while in the lower part the direction of growth is mostly outward.

Secondary growth appears to begin when young vascular bundles are formed within the thickening meristem about midway between the upper and lower limits of the axis. This has usually occurred by the time the seedling is 11 weeks old. Mature vascular bundles consist of a small inner core of phloem surrounded by a much larger amount of xylem, which in turn is surrounded by a sheath of parenchyma. Microfilm \$2.05; Xerox \$7.40. 156 pages.

STUDIES ON *Rhynchosporium secalis* (Oud.)
DAVIS CAUSING SCALD OF BARLEY

(L. C. Card No. Mic 59-2305)

Howard Ernest Reed, Ph.D.
The Ohio State University, 1953

Barley scald caused by *Rhynchosporium secalis* (Oud.) Davis, formerly epiphytotic in the Upper Mississippi Valley and Pacific coastal areas, has now become widespread and destructive in other barley growing regions of North America. The disease affects primarily the foliage, but conidia of the fungus have been obtained from severely stunted heads of barley in the absence of the characteristic leaf symptoms. In east Tennessee, there has been 100 per cent mortality of susceptible barley varieties in some fields in February and March, while 95 per cent losses in grain yields have been sustained in other varieties. The present studies were made in an effort to determine factors responsible for the recent widespread occurrence of the disease and to suggest possible control measures.

Ten isolates from distant parts of the United States and Canada varied considerably in culture regarding sporulation, pigmentation, and topography, but varied little in growth rate on potato dextrose agar. No observable mutations occurred upon potato dextrose agar with buffered pH values ranging from 2.35 to 11.5, and on potato dextrose agar incubated at six different temperatures ranging from 2 to 30° C. Best growth of all isolates occurred on the buffered medium with a pH of 5.2 and on the potato dextrose agar incubated at 19° C. Considerable variation between isolates in growth rate occurred upon beef extract agar, a synthetic medium containing two concentrations of biotin, thiamin, and niacin separately, and on the synthetic medium with the three vitamins together in the lower concentration. This would indicate the probable existence of different enzymatic systems in the different isolates, which could affect their pathogenicity. Fourteen different variant cultures obtained from sectors of 8- to 10-week-old cultures in test tube slants varied greatly from their parent cultures and from each other in pigmentation, growth rate, topography, and sporulation. They retained their respective characters upon repeated transfer and were, on the basis of nuclear studies, considered mutants. Comparisons were made of pathogenicity of the same 14 mutants and their parent cultures on four barley varieties in the greenhouse. Most mutants were either nonpathogenic or weakly pathogenic. Inoculation of two monoconidial isolates from barley upon 15 different grasses, rye, wheat, barley, and oat resulted in the two isolates affecting only barley. Comparison of the scald-disease susceptibility of 117 different barley varieties in the field at Knoxville, Tennessee, with their susceptibility as reported elsewhere in the United States, Mexico, and Argentina demonstrated considerable differences in susceptibility in over one fourth of all varieties at any two places. Greatest variation in varietal susceptibility was between those obtained at Knoxville, Tennessee, and those obtained in Argentina.

Inoculation of 20 monoconidial cultures of *R. secalis* from barley leaves, obtained throughout the United States and Canada, upon 24 different barley varieties in the greenhouse, agreed in most cases with scale susceptibility ratings obtained in the field. Seven barley varieties dif-

ferentiated 16 physiologic races among the 20 isolates. The occurrence of physiologic races in the barley isolates of *R. secalis* would account in part for differences in scald susceptibility at different places. In studies on epiphytology of the disease in the field it was found that the fungus overseasoned, probably as stromata, on the plant refuse from the preceding season along fence rows and plot borders where such plant refuse was not turned under. Scale-diseased plant refuse failed to produce inoculum the second season in the field or after 20 months in the 5° C. refrigerator. Thus, a one year rotation of barley with some other crop would help minimize the disease in Tennessee, if inoculum was not introduced from an outside source. Studies on the initial occurrence of scald in a disease-free area indicated that the primary inoculum may come from small fragments of scald-diseased leaves, which were mixed with the seed and left exposed at the ends of drill rows. It was found from field tests of scald susceptibility of 150 barley breeding selections, and of the parent breeding lines, that 86 per cent of the parent lines and 84 per cent of the selections were susceptible. It seems clear that use of highly scald-susceptible barley breeding lines is in part responsible for the widespread occurrence and severity of scald.

Microfilm \$2.00; Xerox \$3.80. 70 pages.

Abstract published by special arrangement with The Ohio State University.

NUTRITION AND METABOLISM OF
PHOTOSYNTHETIC MICROORGANISMS
EXPOSED TO ELEVATED TEMPERATURES
AND THERMOMIMETIC DRUGS

(L. C. Card No. Mic 59-1827)

Stanley Scher, Ph.D.
Rutgers University, 1959

Major Professor: Dr. E. T. Moul

To study the biochemical prerequisites of tolerance to high temperatures as a guide to understanding the ecology of eurythermal forms in nature, the nutrition of some photosynthetic microorganisms has been studied in chemically defined media, at temperatures above their ostensible optimum, and in the presence of certain drugs which appear to induce the metabolic equivalent of temperature stress. *Euglena gracilis* z, *Ochromonas malhamensis*, *Rhodospseudomonas palustris*, and *Spirodela oligorhiza* served as experimental objects representing green and brown pigmented algae, non-sulfur photosynthetic bacteria, and higher plants respectively. When cultivated above their normal temperature range, these organisms require nutritional supplements to overcome thermally-induced blocks in metabolism. Comparative studies with chemical agents such as sulfanilamide suggests that some components of temperature can be studied by employing simple chemical models.

At 34-35° C. apochlorosis was observed in *Euglena*. Treatment of *Euglena* and *Spirodela* with 3-amino-1,2,4-triazole failed to induce permanent bleaching in these organisms. Streptomycin controls induced permanent

bleaching in *Euglena* but not in *Spirodela*. Growth inhibition at elevated temperatures and in the presence of these chemical bleaching agents is reversed by supplying higher than normal quantities of trace elements. This suggests that both temperature and these chemical bleaching agents may act by competing for essential metals.

Organic requirements for growth of *Euglena* and *Ochromonas* in the critical range, 34-37° appears to reflect a common block in one-carbon metabolism. DL-methionine, threonine and tryptophan are most effective in combination with serine and valine for growth of *Euglena*. Requirements also emerge for adenine thymine and p-aminobenzoic acid. Comparative studies with *Rhodospseudomonas palustris*, a p-aminobenzoic acid requiring member of the *Athiorhodaceae*, and *Euglena* and *Ochromonas* which require p-aminobenzoic acid for growth in the presence of sulfanilamide, suggest that hyperthermia may act as an antimetabolite impairing p-aminobenzoic acid-folic acid function.

At these elevated temperatures, both phytoflagellates require increased quantities of thiamine and vitamin B₁₂, which parallels findings in other experimental organisms. This may be due to an accelerated metabolism at high environmental temperatures comparable to that accompanying fever or administration of thyro-active drugs. Requirements for increased substrates to overcome growth inhibition by 2,4-dinitrophenol or temperature stress help to support this assumption.

Ecological, genetic, and other implications of this work were discussed.

Microfilm \$2.00; Xerox \$5.80. 119 pages.

THE MECHANISM OF MALATE SYNTHESIS IN CRASSULACEAN LEAVES

(L. C. Card No. Mic 59-1646)

Mary Louise Stiller, Ph.D.
Purdue University, 1959

Major Professor: Harry Beevers

A new hypothesis as to the mechanism of malate synthesis in the darkened leaves of Crassulacean plants is presented, and the biochemical and physiological implications which might aid in its evaluation are discussed. These implications are examined experimentally by means of radiochemical, biochemical and physiological methods.

It is proposed that the oxidative reactions of the pentose phosphate pathway participate extensively in the respiratory metabolism of leaves accumulating malate, and that the product of these reactions, ribulose-5-phosphate, upon phosphorylation, serves as the initial CO₂ acceptor. The carboxylation of this acceptor is supposed to give rise to phosphoglyceric acid, which is converted to the malate precursor, phosphoenolpyruvate. Thus two distinct carboxylation reactions would participate in the synthesis of malate, resulting in a predictable pattern of labeling in

this acid; specifically: COOH-CHOH-CH₂-COOH.

In numerous studies of C¹⁴O₂ fixation in darkened leaves of *Kalanchee crenata* and *Bryophyllum calycinum*,

the occurrence of this pattern of labeling is demonstrated, with surprising constancy under a wide variety of conditions, including variations in the time and temperature of fixation. The labeling pattern is compared with those produced in several other tissues during dark fixation of C¹⁴O₂ and found unique to the Crassulacean leaves.

Other experimental attempts to evaluate the proposed mechanism include the feeding of specifically labeled substrates, enzyme studies in cell-free preparations of leaves grown under conditions which alter their ability to accumulate acid, and studies of the effects on the respiration of Crassulacean leaves of agents which affect glycolysis. Although most of the results are of a preliminary nature, and cannot be adduced as proof of the hypothesis, all of them are at least consistent with the hypothesis, and, taken together, present a rational picture of malate synthesis in Crassulacean leaves. Briefly summarized, these results are as follows:

(1) the appearance of label in phosphoglyceric acid, the hypothetical intermediate, at least on some occasions of C¹⁴O₂ fixation in the dark;

(2) the emergence in malate produced from glucose-1-C¹⁴, glucose-2-C¹⁴ and ribose-1-C¹⁴ of labeling patterns which are derivable on paper with the assumption of an extensive production and carboxylation of pentose;

(3) the appearance of label from gluconate-6-C¹⁴ in the non-carboxyl carbons of malate;

(4) the ability of cell-free extracts of leaves to carry out at least one of the oxidative reactions of the proposed mechanism - the oxidation of glucose-6-phosphate;

(5) the relative insensitivity of the respiration to fluoride and its sensitivity to low concentrations of arsenate, iodoacetate and 2,4-dinitrophenol.

Additional experiments, not directly aimed at the evaluation of the hypothesis, but allied to the phenomena of malate synthesis and accumulation in Crassulacean leaves are reported; the results of these experiments may be summarized as follows:

(1) The presence of a large reservoir of labeled malate cannot account for the asymmetries in the glucose produced during photosynthesis in C¹⁴O₂, reported by other workers, at least in the Crassulacean leaves.

(2) Pretreatment of Crassulacean leaves with CO₂-free air in the dark appears to accelerate the rate of acid accumulation when CO₂ is subsequently admitted; with prolonged pretreatment this effect is not obtained.

In a preliminary investigation C¹⁴O₂ fixation in the endosperm material of castor bean seedlings is examined. The appearance of the tracer in the intermediates of the glyoxylate cycle, nitrogenous compounds related to them and in sucrose is reported. Degradations of malate and of the glucose moiety of sucrose reveal that label occurs only in malate carboxyl carbon and primarily in glucose-C-3,4, related to C-1 of malate. The results of CO₂ fixation studies are utilized in the analysis of the fates of specifically labeled pyruvates and acetates in castor bean endosperm, with striking agreement between predicted values and observed results.

Two theoretical sections attempt to define the concepts

of acid accumulation and diurnal fluctuation in the context of the photosynthetic and respiratory metabolism of Crassulacean leaves.

Microfilm \$2.50; Xerox \$8.80. 192 pages.

RELATIONSHIPS AMONG CERTAIN SPECIES
OF *SISYRINCHIUM* IN NORTHEASTERN
NORTH AMERICA

(L. C. Card No. Mic 59-2475)

Daniel Bertram Ward, Ph.D.
Cornell University, 1959

This study was undertaken to obtain knowledge of the patterns of variation within and between the species of *Sisyrinchium* (Iridaceae) in northeastern North America, to employ this knowledge in determining taxonomic relationships, and to develop and apply objective techniques in the interpretation of morphological variation.

Plants of the genus *Sisyrinchium* were studied in 41 populations from Massachusetts and Ontario south to Maryland. The nomenclature of the observed species was reviewed, and the following names were considered to be correct at the specific level: *S. angustifolium* Miller, *S. arenicola* Bicknell, *S. atlanticum* Bicknell, *S. montanum* Greene, and *S. mucronatum* Michaux.

All morphological characteristics suspected to be of taxonomic importance were studied. Plants within populations and observations within plants were selected for study by methods of systematic sampling. Measurements were made from selected plants, and the resulting data were subjected to various statistical analyses and tests. A bias of unknown importance may have been introduced into the results of the tests by the method of sampling and by certain required assumptions. The analysis of variance and F-test were used to detect the presence of significant differences in means among the different species. Range tests and rank-sum tests were used to determine the location of such differences. Components of variance

were calculated as a means of establishing the relative importance of the various characteristics in separating the species.

For each characteristic values were obtained by the computation of tolerance limits which may be expected to contain between them a known percentage of the individuals of the species.

The results of the tests of significance, the observed values, and the calculated tolerance limits are presented in tabular form.

An equation is given for the determination of that point (point of equal error) which will separate two overlapping distributions of a characteristic in such a way that the likelihood of misassigning individuals is equal for the two species. A technique is presented for calculating the percentage of individuals which may be expected to be classified correctly by the point of equal error. A key to the species is constructed using these values.

A method of constructing a hybrid index was developed. It is believed to be superior to conventional hybrid indices in that the new method will result in the use of objectively selected characteristics, and in that the new method inherently gives a more important characteristic greater weight in the index. The new method is inferior in the greater amount of time required for its construction.

Chromosome counts or approximate counts were obtained for the above taxa and for the hybrid between *S. angustifolium* and *S. montanum*.

Isolating mechanisms were studied for all species. Mechanisms found to be present were ecological, seasonal, and chromosomal, this last being manifested both in hybrid sterility and hybrid inviability.

The presence of morphological gaps, as determined by the hybrid index, and effective isolating mechanisms led to the conclusion that *S. angustifolium*, *S. atlanticum*, *S. montanum*, and *S. mucronatum* should be maintained at the level of species. Similar chromosome numbers and morphological intergradation suggested that *S. atlanticum* and *S. arenicola* are conspecific. The following new combination is proposed: *S. atlanticum* Bicknell subsp. *arenicola* (Bicknell).

Microfilm \$3.55; Xerox \$12.00. 275 pages.

CHEMISTRY

CHEMISTRY, GENERAL

ANALYTICAL APPLICATIONS OF GAS CHROMATOGRAPHY

(L. C. Card No. Mic 59-1615)

Allen Ainsworth Duswalt, Jr., Ph.D.
Purdue University, 1959

Major Professor: Warren W. Brandt

A method has been developed for the analysis of carbon and hydrogen by means of gas-solid chromatography. The method involves the combustion of the sample in an oxygen stream, changing the water vapor to acetylene by means of reaction with calcium carbide and condensing the carbon dioxide and acetylene in a liquid nitrogen freeze trap. The revaporized sample gases are then swept into the chromatographic system by helium where they are separated and analyzed. The method has a precision of 0.3% for carbon and 0.05% for hydrogen. The time for combustion, separation and recording peaks is 16 minutes. On a continuous basis, a new sample may be started every 9 to 10 minutes. Compounds containing the elements of oxygen, nitrogen, sulfur and halogen have been run without difficulty. The halogens and sulfur products were adsorbed in the combustion tube. The peaks from the oxygen and nitrogen components come through the column much before those of the carbon dioxide and acetylene and do not interfere.

The feasibility of determining metallic ions by means of injecting their volatile chelates into a gas chromatographic column, has been investigated. Initial results indicate that the Zn, Be and Sc chelates of acetyl acetone, can be put through a column to produce chromatographic peaks. Probable development of an analytical method for these and other metal chelates is indicated.

An analytical scheme has been worked out for the *t*-butyl phenol isomers and phenol. Using helium as the carrier, di-isodecyl phthalate as the liquid substrate and operating at a temperature of 136° C., allowed the successful development of a quantitative and qualitative method of analysis for the phenols.

Ideas have been proposed for further research concerning a) separation of gaseous components by a magnetic field effect, b) the design of a thermal conductivity cell of increased sensitivity and c) the use of organic vapors as eluents in gas-liquid partition chromatography.

Microfilm \$2.00; Xerox \$5.20. 103 pages.

ANALYTICAL APPLICATIONS AND EXTRACTION STUDIES OF SOME METAL CHELATE COMPOUNDS OF BENZOHYDROXAMIC ACID

(L. C. Card No. Mic 59-1631)

Clifton Edward Meloan, Ph.D.
Purdue University, 1959

Major Professor: Warren W. Brandt

The reaction of the uranyl ion with benzhydroxamic acid ($C_6H_5CONHOH$) is proposed as a spectrophotometric method for determining uranium(VI) between 200 and 12,000 gamma. The aqueous system forms a red color at pH 3-5 and a red-orange color at pH's more basic than 6. The above species are the 1:1 and the 1:2 respectively. The chelate is prepared in aqueous solution at pH 6.2 and extracted into 1-hexanol. The absorbance is measured at 380 mμ and the extracted chelate follows Beer's Law in all alcoholic extractants. An orange precipitate is formed in aqueous solution above a concentration of 1.6×10^{-3} M at pH 6. Analysis of the precipitate has shown the formula to be $UO_2(C_6H_5CONHO)_2 \cdot H_2O$.

The benzhydroxamic acid chelates of uranium(VI), vanadium(V) and iron(III) are destroyed when they are extracted into 1-hexanol that had not been freshly distilled. The cause of this chelate destruction was found to be due to traces of hydrogen peroxide being formed in the alcohol. The uranium(VI) chelate reacts with hydrogen peroxide in a 1:1 ratio. The formation of hydrogen peroxide may be eliminated satisfactorily by storing the 1-hexanol in a metal container. The formation of hydrogen peroxide was found to occur also in isoamyl alcohol, *n*-amyl alcohol, *n*-heptanol, *n*-octanol and cyclohexanol.

The nature of the extraction process was studied and it was found that there were 6 ± 1 molecules of water associated with the uranium(VI)-benzhydroxamic acid chelate and 9 ± 2 molecules of water associated with the iron benzhydroxamic acid chelate if the chelate systems were extracted with decanol. The Karl Fischer reagent combined with the dead stop method for endpoint detection was used in these experiments.

Microfilm \$3.25; Xerox \$11.00. 250 pages.

SPECTROPHOTOMETRIC STUDY OF LEWIS
ACID-BASE REACTIONS IN ORGANIC SOLVENTS

(L. C. Card No. Mic 59-1829)

Raymond J. Shuba, Ph.D.
Rutgers University, 1959

Major Professor: S. T. Zenchelsky

All work was performed using a dry box technique. The criterion of dryness was the stability of anhydrous aluminum bromide on exposure to the dry box atmosphere.

The interaction between stannic chloride and aluminum bromide with tribenzylamine in 1,2 dichloroethane was studied spectrophotometrically. Both metal halides formed a 1:1 adduct in the concentration range 10^{-3} to 10^{-5} M. The reactions were essentially complete with both acids. The ultraviolet absorption spectra of the addition products are very similar to that reported for tribenzylamine oxide. This suggests that the N-acid bonding is highly ionic as found for the N-O bond. At one molar concentrations, the reaction products precipitate out of dichloroethane. The stannic chloride adduct was analyzed as the solid and showed the same 1:1 ratio observed in solution. Aluminum bromide, on the other hand, indicated a 2:3 acid-to-base ratio in the solid product.

Little quantitative work has been done in the study of the interaction of Lewis acids with ordinary acid-base indicators. The method of continuous variation was employed to determine the stoichiometry of the reaction for the system ferric chloride-4-aminoazobenzene, and stannic chloride-4-aminoazobenzene, in 1,2 dichloroethane. For both systems, the stoichiometry observed was three moles of acid to two moles of base. The continuous variation plots indicated that the reactions were essentially complete and showed no evidence of more than one product in solution. It was possible to back-titrate the metal halide-dye complex with tribenzylamine spectrophotometrically. Since the stoichiometry for the stannic chloride-tribenzylamine reaction had previously been determined, the A_3B_2 stoichiometry for the stannic chloride-dye complex could be substantiated by measuring the base liberated on addition of the stronger base, tribenzylamine. Pyridine also appeared to be a stronger base than 4-aminoazobenzene.

The solid addition products of stannic chloride and ferric chloride with 4-aminoazobenzene were prepared and analyzed. The stoichiometry was two moles of base per mole of acid for both systems.

trans-Azobenzene in 1,2 dichloroethane appears to interact with one mole of ferric chloride or of stannic chloride with intensification of the weak absorption band at 450 m μ . No spectral shift occurs as in the case of 4-aminoazobenzene. A time-dependent reaction occurs with azobenzene in the presence of the metal halides due either to partial acid addition to the second azo nitrogen or to some side reaction. It is doubtful that the possible conversion of *trans*-azobenzene to *cis*-azobenzene occurs.

The behavior of ferric chloride with 4-aminoazobenzene, in benzene, was similar to that described for the system in 1,2 dichloroethane. Stannic chloride appeared to form more than one product with 4-aminoazobenzene in benzene. The presence of two additional absorption bands was indicated by the spectrum. Unfortunately, the solutions were turbid, indicating formation of one or more insoluble products, and it was not possible to study the system quantitatively.

Aniline formed a 1:1 complex with ferric chloride in 1,2 dichloroethane. Stannic chloride forms an insoluble product with aniline and could not be studied in solution. The solid was analyzed and found to have an acid-to-base ratio of 1:2.

The infrared spectra of tribenzylamine, azobenzene, 4-aminoazobenzene and the solid adducts for stannic chloride and ferric chloride with 4-aminoazobenzene in KBr discs are presented and briefly discussed in one of two Appendices.

A number of systems, which were not easily amenable to spectrophotometric study, were investigated and are discussed in an Appendix.

Microfilm \$2.00; Xerox \$5.40. 107 pages.

I. THE APPLICATION OF GAS
CHROMATOGRAPHY TO THE
DETERMINATION OF SOME PHYSICAL
CONSTANTS. II. HIGH TEMPERATURE
GAS CHROMATOGRAPHY.

(L. C. Card No. Mic 59-2061)

Francis Masayuki Wachi, Ph.D.
University of Illinois, 1959

Part I

The use of gas chromatography for the determination of equilibrium constants and reaction rate constants of some reversible reactions has been investigated. In particular, the alcoholysis of ethyl propionate, *n*-propyl propionate, and ethyl *n*-butyrate with methanol, the alcoholysis of methyl propionate with ethanol, the alcoholysis of methyl propionate with 1-propanol, and the simultaneous alcoholysis of methyl propionate and methyl *n*-butyrate mixture with ethanol in the presence of dry hydrogen chloride catalyst were examined. The equilibrium constants and the rate constants of these reactions have not previously been measured. These reactions were chosen because the reaction mixtures, consisting of two alcohols and two esters, are particularly difficult to analyze by conventional methods. The purpose of the work was not to determine, or redetermine, a large body of fundamental physical data, but rather to establish the reliability of a method which would permit the evaluation of these data with greater ease and precision than previously possible.

Since the point of chemical equilibrium of these reactions may be approached from either side with equal facility, in certain cases the equilibrium constant has been evaluated from both directions. The effect of temperature upon the equilibrium constants was also investigated, and the results were interpreted with respect to the Arrhenius activation energies for the forward and reverse reactions. The standard deviation for the equilibrium constant measurements was found to be within 1.2 per cent of the mean value.

A kinetic study based on the gas chromatographic method of analysis is described. Apparent rate constants and the activation energy for the alcoholysis of *n*-propyl propionate with methanol in the presence of dry hydrogen chloride catalyst were determined. The standard deviation for the measurements of the rate constants was found to be within 3 per cent of the mean values.

Part II

Two types of high temperature gas chromatography units suitable for use in the temperature range between 30 and 500° are described.

An all-metal apparatus using model airplane glow plugs as sensing elements is a revision of an original instrument designed by Felton and Buehler of E. I. du Pont de Nemours & Co., Inc. The sample port and the detector cell compartment were redesigned to increase the efficiency of separation and to increase the sensitivity of response of the glow plug detector. This unit was applied to the separation of solid materials and high-boiling liquids (b.p. > 325°).

An all-glass apparatus employing platinum filaments as sensing elements is also described. This unit was used in exploratory studies on the application of nonvolatile inorganic eutectics and low-melting inorganic salts as stationary liquid phases for the separation of volatile inorganic materials. In particular, the cadmium chloride-potassium chloride eutectic, the aluminum chloride-sodium chloride eutectic, and the bismuth chloride-lead chloride eutectic were used as stationary liquid phases for the separation of volatile transition metal chlorides (e.g., stannic chloride, antimony trichloride, and titanium tetrachloride). Although complete separations were not attained, the results of these preliminary studies indicate that nonvolatile inorganic eutectics and low-melting inorganic salts may be useful as partition media for the separation of volatile inorganic materials. Microfilm \$2.00; Xerox \$6.80. 142 pages.

CHEMICAL, ANALYTICAL

POLAROGRAPHY AND ACID-BASE PROPERTIES IN N-METHYLACETAMIDE

(L. C. Card No. Mic 59-2358)

Laurance Arthur Knecht, Ph.D.
University of Minnesota, 1959

Because of its unusually high dielectric constant (165.5 at 40°) N-methylacetamide is an excellent solvent for many ionic inorganic substances and their degrees of dissociation into ions in this solvent are generally high. An attempt was made in this research to determine the suitability of this solvent as a medium for electrochemical reactions and acid-base titrations which cannot be carried out in water.

A great deal of difficulty was encountered in the purification of N-methylacetamide prepared from glacial acetic acid and aqueous methylamine. Purification methods described in the literature appeared to be undesirable from the standpoints of time, yield or purity. After many attempts, two purification procedures, probably no less time-consuming than those described in the literature, were developed which yielded pure N-methylacetamide. The purity of the product was confirmed by polarographic and conductance measurements and by Karl Fischer titration.

The relatively high viscosity of N-methylacetamide (0.0302 poise at 40°) causes extremely low conductances in this solvent. Polarographic cell resistances are corre-

spondingly very high. Therefore, considerable attention was directed to proper correction of the applied e.m.f. for the large iR drop across the cell. This problem, complicated by the fact that the resistance changes during the growth of the mercury drop, was solved by measuring the maximum value of the current and the corresponding minimum value of the cell resistance (at maximum drop size) and calculating the iR correction using these values. Subsequently, instantaneous values of i and E (at $t = t_{\max}$) were used instead of the customary "average" values in plotting and analyzing the polarographic wave.

The polarographic range of N-methylacetamide, with Et_4NClO_4 as supporting electrolyte, is +0.3 to -2.7 volts (D.M.E. versus aqueous S.C.E.). Half-wave potentials for the reductions of Cu^{++} , Ti^+ and O_2 are +0.069, -0.421 and -0.539 volt, respectively. Diffusion current constants for Cu^{++} and Ti^+ are 1.77 and 1.53, respectively. Anodic depolarization by 0.1 M halide ions (Cl^- , Br^- and I^-) occurs at 0.00, -0.15 and -0.40 volt, respectively.

The polarograms of perchloric and hydrochloric acids are practically identical, while that of sulfuric acid is complicated by the dissociation of the second proton of this acid. Acetic acid definitely exhibits weak acid behavior.

Potentiometric titrations with the glass electrode of hydrochloric, sulfuric and acetic acids, and conductance measurements on hydrochloric and sulfuric acids confirm the conclusions that perchloric and hydrochloric are strong acids (completely dissociated) in N-methylacetamide, that K_2 for sulfuric acid is smaller in this solvent than it is in water (two breaks are observed in the titration of this acid with NaOH in N-methylacetamide), and that acetic acid is definitely a weak acid in this solvent. Thus it appears that N-methylacetamide is a weaker base than water.

Conductance measurements on weak acids in this solvent were of limited accuracy because an appreciable fraction of the total conductance of an N-methylacetamide solution is contributed by the solvent itself (sp. cond. = 1 to $3 \times 10^{-7} \text{ ohm}^{-1} \text{ cm}^{-1}$). Conductance measurements on weak bases in N-methylacetamide were complicated further by the decomposition (hydrolysis) of the solvent in these solutions.

E.m.f. measurements using the hydrogen electrode (versus a silver-silver chloride electrode in the solvent) gave reproducible and reliable results in solutions of acids. Conflicting results were obtained in solutions of the bases diphenylguanidine, sodium hydroxide and sodium. The glass electrode also yielded unreliable results in alkaline media. Therefore, it was impossible to determine a reliable value for the autoprotolysis constant of N-methylacetamide. However, it was established that hydroxyl ion is a strong base in N-methylacetamide. Consequently, N-methylacetamide appears to be a stronger acid than water.

Several very preliminary observations using indicator bases in N-methylacetamide revealed that the color change from basic to acidic form is not reversible.

Microfilm \$2.10; Xerox \$7.40. 159 pages.

CHEMISTRY, BIOLOGICAL

THE LETHAL AND TERATOGENIC EFFECTS
OF BENZIMIDAZOLE AND BENZENE
ANALOGUES IN THE CHICK EMBRYO AND THE
INFLUENCE OF VITAMIN B₁₂ ON THESE EFFECTS

(L. C. Card No. Mic 59-1889)

Unabelle Rebecca Boggs Blackwood, Ph.D.
University of Maryland, 1958

Supervisor: Professor Mary S. Shorb

Lethal and teratogenic effects of several inhibitors structurally related to vitamin B₁₂ were studied in chick embryos following injection into the albumen at 0 and 1½ days and into an extraembryonic sac at 6, 7, 8, and 10 days of incubation. Vitamin B₁₂ was tested for reversal of three inhibitors.

Control solutions most resembling inhibitor solutions (i.e. dilute HCl, metabolites in HCl, and B₁₂) produced approximately the same mortality and incidence of anomalous embryos as found in the noninjected control groups (0-13%). Inhibitor mortality ranged from 0 to 100% and anomalies, 0-70%.

The relative lethal and teratogenic activities (measured by mortality and incidence of anomalous embryos and compared on a molar basis) of the inhibitors injected prior to incubation were as follows from the most to the least effective: 2-ethyl-5-methylbenzimidazole (injected during February-March into White Leghorn, Mount Hope, eggs), 2-hepta-5-methylbenzimidazole, 2-ethyl-5-methylbenzimidazole (injected during October-November into White Leghorn, random bred, eggs), 1,2-dichloro-4,5-diaminobenzene, 2,5-dimethylbenzimidazole, 1,2-dimethyl-4,5-diaminobenzene, and methylamide.

Variation in the lethal and teratogenic effect of 2-ethyl-5-methylbenzimidazole when injected at 0 and 1½ days of incubation were correlated with seasonal and/or genetic differences. There was also a correlation between these factors and the influence of vitamin B₁₂ on the actions of 2-ethyl-5-methylbenzimidazole at 0 and 1½ days and of 1,2-dichloro-4,5-diaminobenzene at 1½ days. B₁₂ exerted its greatest effect during February to June and least during October and November.

The inhibitors induced malformations on embryos which died at characteristic stages of development. The anomalous embryos were grouped: early (33-64 hours), middle (3-6½ days), and late (6½-14 days), and the inhibitors were characterized by the predominate stages of development of anomalous embryos.

The four most effective teratogenic compounds induced a number of different types of malformations; the predominate types being more or less characteristic of the compound. While all these inhibitors induced dextroversion and "collapsed" right optic lobe and eye, 2-hepta-5-methylbenzimidazole was the most effective. 2-Ethyl-5-methylbenzimidazole induced the greatest number of different types of malformations.

Increasing the age of embryos at injection from 0 to 1½ days affected the stages of anomalous embryos and the types of malformations, but had little effect on mortality or incidence of anomalous embryos produced by both 2-ethyl-5-methylbenzimidazole and 1,2-dichloro-4,5-diaminobenzene. The predominate types of malformations did not vary

for the benzimidazole but was completely changed for the benzene. When injected at 0 days, the benzene caused primarily beak malformations, but at 1½ days it primarily inhibited the development of the trunk below the level of the heart. The benzimidazole, to a lesser extent, induced "trunklessness" and acephaly at 0 and 1½ days. Vitamin B₁₂ decreased trunklessness and enhanced or provoked acephaly from both inhibitors. Apparently the benzene differentially interrupts the trunk organizer, the benzimidazole interrupts both head and trunk organizers, and B₁₂ plays a role in primary differentiation.

High levels of vitamin B₁₂ affected teratogenicity to a greater extent than lethality, partially reversing the effects of 2-ethyl-5-methylbenzimidazole and 2-hepta-5-methylbenzimidazole and enhancing the effects of 1,2-dichloro-4,5-diaminobenzene. 2-Ethyl-5-methylbenzimidazole was reversed at 0 and 1½ days but not at 6-7 days, while 1,2-dichloro-4,5-diaminobenzene was enhanced at 1½ and 6-7 but not 0 days. These differences in B₁₂ effect at various ages correspond to changes of slopes of log dose response curves (based upon mortality and molar concentration in total embryonic tissue) of both inhibitors.

The LD₅₀ of 2-ethyl-5-methylbenzimidazole and LD₅₀ of 1,2-dichloro-4,5-diaminobenzene (obtained from dose response curves) greatly decreased during the first week of incubation, decreased slightly from 6 to 10 days for the benzimidazole, increased at 8 days and was too great for determination at 10 days for the benzene.

Microfilm \$2.00; Xerox \$5.60. 114 pages.

AN IN VIVO N¹⁵ TRACER STUDY OF AMINO
ACID METABOLISM IN THE RUMEN
OF SHEEP ON A PURIFIED DIET

(L. C. Card No. Mic 59-2463)

Dallas Ervin Boggs, Ph.D.
Cornell University, 1959

Applications of N¹⁵ isotopic tracer experiments to studies of amino acid metabolism in the rumen have been demonstrated and discussed. A procedure suitable for isolation of amino acids in quantities adequate for nitrogen tracer experiments has been developed. It involves the use of acetate buffers for elution of amino acids from ion exchange columns of large cross section. The procedure is applicable to rapid screening of biological systems.

Isotopic nitrogen in the form of ammonium sulfate was introduced into the rumens of two different sheep on a purified diet. Samples of the rumen contents were removed at several time intervals after introduction of the labeled ammonia. Three different types of preparations from the rumen liquor were studied: 1. Whole rumen liquor was measured for excess N¹⁵, and changes with time were noted for three to six hours. 2. The rumen liquor was partitioned on N¹⁵ assays at different time intervals on fractions consisting of protozoa, bacteria, soluble protein, and non-protein nitrogen. 3. Samples of the rumen liquor were hydrolyzed, and the N¹⁵ abundance in seventeen amino acids and ammonia, obtained by ion exchange chromatography, was measured at two different time periods for each sheep.

Data from the whole rumen liquor were used to estimate

the liquid volume of the rumens of the experimental animals. Results from the rumen liquor fractions are discussed regarding the relative rates of ammonia fixation in the bacteria, protozoa, and other fractions. Evidence is presented that glutamic and aspartic acids play an important role in fixation of ammonia into amino acids in the rumen. Microfilm \$2.00; Xerox \$3.00. 42 pages.

THE CHROMATOGRAPHY AND BIOSYNTHESIS OF THE CEREBROSIDES

(L. C. Card No. Mic 59-2223)

Ann Esther Kaplan Bresler, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Samuel Gurin

Improved methods were found for isolating and purifying the cerebroside from rat brain homogenates. These methods were employed in studying the biosynthesis of the cerebroside, *in vitro*, using radioactive substrates containing Carbon-14. (a) The cerebroside was extracted from aqueous homogenates of rat brain by the use of chloroform and methanol mixtures. Extracts were collected, reduced in volume and dried by lyophilization. The dry brain lipids were chromatographed on silicic acid columns. Cholesterol was eluted with chloroform. Gradient elution with methanol and chloroform was used to obtain cerasine, phrenosine and a ceramide fraction. (b) The cerebroside fractions were rechromatographed on a reverse phase column with a solvent system of glacial acetic acid, water, and chloroform (5:5:2). Any traces of phospholipids remaining after chromatography on silicic acid were eluted with the solvent front on the second column. The cerebroside was eluted by increasing the acid content of the moving phase. Crystalline preparations of phrenosine and cerasine were obtained after chromatography on the reverse phase column. (c) The cerebroside was hydrolysed and their three components, galactose, sphingosine and fatty acid, chromatographed on paper for further identification. A paper system was developed for separation of the 24-carbon fatty acids from cerasine and phrenosine. (d) The biosynthesis of the cerebroside was studied in homogenates of rat brain. Sodium acetate-1-C¹⁴ and palmitic acid-1-C¹⁴ were incorporated into cerebroside under the experimental conditions using homogenates from fifteen day old rats. Older rats (24 days and 6 weeks) did not incorporate radioactive precursors into these lipids. (e) Phrenosine, isolated after incubating the homogenate with palmitic acid-1-C¹⁴, was purified by the two chromatography systems described above and then hydrolysed. After chromatography of the three components, the radioactivity of the fatty acid was found to account for 90% of the activity in phrenosine. No measurable radioactivity was present in sphingosine or galactose.

Microfilm \$2.00; Xerox \$5.00. 95 pages.

INTRACELLULAR DISTRIBUTION OF MANGANESE AND THE EFFECT OF DIETARY MANGANESE ON RAT LIVER ARGINASE

(L. C. Card No. Mic 59-1610)

Donald A. Burns, Ph.D.
Purdue University, 1959

Major Professor: Herbert E. Parker

Three groups of rats were fed experimental diets containing 0.37, 40, and 400 parts per million manganese representing low, normal, and high levels of the element, respectively. The intracellular distribution of manganese was determined by differential ultracentrifugation of a rat liver homogenate, manganese being determined on a dry weight basis in the following particulate fractions: the original homogenate, the sediment at 700 x G (all solid materials except mitochondria), and the mitochondria. Dry liver was shown to contain 8.9 p.p.m. manganese. Mitochondrial particles were shown to represent 19 percent of the liver and to contain 27 percent of the total manganese, having concentrated it 1.4 times to nearly 13 p.p.m. Increasing the dietary manganese ten-fold was shown to nearly double the total liver manganese, while mitochondrial manganese was increased eleven times. Microsomal manganese showed an overall 36-fold increase, suggesting that they might be a storage depot for the element.

Five methods of disrupting mitochondrial membranes were studied, and freezing-and-thawing was shown to be the most effective method since it produced a two- to three-fold increase in the number of proteins as determined by Tiselius moving-boundary electrophoresis patterns. The isoelectric points of three of these proteins were determined to be 4.62, 5.05, and 5.40. One of these proteins, pI = 5.05, was shown to have a mobility of $32.5 = 1.8 \times 10^{-6}$ cm²/volt-second in barbital buffer at pH 8.60, and evidence was presented which indicated it was arginase.

Data were presented showing that arginase is inactivated by manganese in concentrations above 0.01-molar, and that this inactivation is the result of manganous ions and not merely one of increased ionic strength. The optimum concentration of manganese for greatest activation of arginase was established as 1.8×10^{-3} molar.

From an examination of several Tiselius electrophoresis patterns, it was demonstrated that lowering the dietary manganese from 40 p.p.m. to 0.37 p.p.m. decreased the arginase concentration from 7.06 percent to 6.52 percent of the total soluble liver proteins. Also, when the dietary manganese was increased to 400 p.p.m., the arginase concentration was shown to be decreased to 5.57 percent.

For use in the determination of arginase activity, a colorimetric modification of the xanthidol method of urea detection has been developed wherein the chromic ion produced by the reduction of dichromate ion can be determined without interference by the latter at 637 millimicrons. The method is as sensitive as and as accurate as the usual iodometric titration and is considerably faster.

Microfilm \$2.00; Xerox \$5.00. 98 pages.

STUDIES OF ISOCITRIC DEHYDROGENASES

(L. C. Card No. Mic 59-2439)

Michael Carsiotis, Ph.D.
New York University, 1959

Adviser: Gerhard W. E. Plaut, Ph.D.

A number of properties of the Triphosphopyridine nucleotide (TPN)-linked and Diphosphopyridine nucleotide (DPN)-linked isocitric dehydrogenases of various animal tissues have been studied.

1. Oxalsuccinate has been shown not to be a free intermediate in the overall reaction $\text{isocitrate} + \text{TPN}^+ = \alpha\text{-ketoglutarate} + \text{CO}_2 + \text{TPNH} + \text{H}^+$ catalyzed by the TPN-linked enzyme.

2. The studies with soluble TPN-linked enzyme have shown a requirement for manganese ion for the reaction $\text{oxalsuccinate} + \text{TPNH} + \text{H}^+ = \text{isocitrate} + \text{TPN}$.

3. Supporting proof that TPN-linked isocitric dehydrogenase and oxalsuccinic carboxylase are the same enzyme has been obtained.

4. Supporting proof of the theory that the isocitric dehydrogenase and oxalsuccinate activities occur at the same site of the TPN-linked enzyme has been presented.

5. It was found that α -ketoglutarate can protect the TPN-linked enzyme against inhibition by p-chloromercuribenzoate if it is added to the enzyme before the inhibitor is added.

6. The protection of the TPN-linked enzyme against inhibition by p-chloromercuribenzoate by isocitrate or TPN requires the presence of manganese ion.

7. The DPN-linked enzyme (swine heart) has been found to be inhibited by sulfhydryl reagents, e.g., p-chloromercuribenzoate.

8. A new method of purifying the TPN-linked enzyme has been developed.

9. The DPN-linked enzyme has been shown to be competitively inhibited by adenosine-2'-phosphate.

(a) Adenosine-2'-phosphate has also been shown to inhibit glutamic dehydrogenase only in the presence of magnesium ions.

Microfilm \$2.00; Xerox \$4.20. 78 pages.

CONFORMATION OF AMYLOSE IN SOLUTION

(L. C. Card No. Mic 59-1616)

Wilbur Wayne Everett, Ph.D.
Purdue University, 1959

Major Professor: Joseph F. Foster

A potato amylose sample was separated into seven subfractions by fractional precipitation with absolute ethanol in dimethylsulfoxide. A detailed study of the angular and concentration dependence of scattered light from dimethylsulfoxide solutions of these fractions led to values for the weight-average molecular weights, Z-average root-mean-square radii of gyration, and P_{90}^{-1} versus $\sin^2 \theta/2$ curves for each of the subfractions. The weight-average molecular weight varied from 2.22×10^6 for the highest to 1.52×10^3 for the lowest molecular weight subfractions.

The P_{90}^{-1} curves were linear within experimental error, and the radii of gyration varied as the square root of the molecular weight.

Light scattering experiments were also carried out on the highest subfraction in 1 N KOH and 0.5 N KCl. The molecular weights obtained in these solvents agreed with those determined in dimethylsulfoxide within experimental error.

The weight- and Z-average molecular weights of the highest molecular weight subfraction were obtained at 25°C. in 0.5 N KCl in the ultracentrifuge by utilizing the Archibald principle. This gave a value for the weight-average molecular weight which agreed with those determined by light scattering, and \bar{M}_z/\bar{M}_w was found to be 1.28.

The limiting viscosity numbers of the fractions were determined in dimethylsulfoxide, aqueous 0.5 N KOH, and aqueous 0.33 N KCl. These limiting viscosity numbers were plotted against the weight-average molecular weights obtained in dimethylsulfoxide on a log-log plot, and the constants in the following equations were determined from this plot:

$$[\eta]_{\text{KOH}} = 8.50 \times 10^{-5} M_w^{0.763}$$

$$[\eta]_{\text{DMSO}} = 3.06 \times 10^{-4} M_w^{0.840}$$

$$[\eta]_{\text{KCl}} = 1.13 \times 10^{-3} M_w^{0.503}$$

where $[\eta]$ is in deciliters per gram and DMSO stands for dimethylsulfoxide. Straight lines were obtained for the data in all three of the solvents.

A weight fraction distribution curve was obtained from the fractionation and molecular weight data. The curve was smooth and possessed only a single peak. This curve was compared with a theoretical curve for a polymer formed by bifunctional condensation polymerization. The agreement between the curves was considered to be fair in light of the inherent experimental errors encountered in obtaining the experimental curve.

The exponents in the viscosity equations (equations 1) are in excellent agreement with the theoretical exponents for random or somewhat expanded coils. The results of light scattering also showed the amylose to be in a coiled conformation in these solvents.

From the light scattering and viscosity data the Theta point for amylose in aqueous KCl solution seemed to be about 25°C. It was shown that the viscosity theory for a random coil applies to amylose in the aqueous KCl solution.

The specific rotation of amylose was determined in various compositions of the solvent pairs ethylenedichloride-dimethylsulfoxide, ethylenedichloride-dichloroacetic acid, and ethanol-dimethylsulfoxide in an effort to find a conformational change. Under the conditions used, no change in specific rotation was observed; however precipitation did take place from dimethylsulfoxide, and when ethylenedichloride was the precipitant the precipitation had a positive temperature coefficient (i.e., at constant composition the amount of precipitate increased with increasing temperature). The dichloroacetic acid formed a monoester with the amylose under the mild conditions used to obtain the solution of amylose in dichloroacetic acid. This monoester hydrolyzed very quickly in a mixture of dilute base and acetone.

Microfilm \$2.35; Xerox \$8.20. 178 pages.

IN VITRO STUDIES ON PROTEIN BIOSYNTHESIS

(L. C. Card No. Mic 59-1619)

Joseph Leo Haining, Ph.D.
Purdue University, 1959

Major Professor: Bernard Axelrod

The development of a fully integrated concept of protein synthesis would be greatly aided by the availability of a cell-free preparation in which net synthesis of a specific protein can be achieved. In this investigation the search for a cell-free system capable of *de novo* protein synthesis has been extended to xanthine oxidase of rat liver, taking advantage of the fact that the liver can be readily depleted of this enzyme through feeding the rats a protein-free diet. It was anticipated that in this way a tissue with an improved potential for synthesis of xanthine oxidase could be obtained and used for subsequent *in vitro* operations.

In a separate study a recent development concerning the mechanism of amino acid incorporation into proteins, namely, the suggestion that lipides might be directly involved, has been investigated for the first time in a cell-free system.

Xanthine oxidase activity in rat liver slices or homogenates was found to decrease during incubation in a medium contrived to be conducive to protein synthesis. The decline in activity in preparations from depleted animals was dependent upon the presence of oxygen and generally leveled off after the first hour of incubation. This stabilization of xanthine oxidase activity, which might be interpreted as a balance between destructive and synthetic processes, was unaffected by known inhibitors of protein synthesis. The enzyme was much more labile in cell-free homogenates than in tissue slices. Slight increases in activity were observed upon incubating liver slices from rats which had been partially depleted of the enzyme and then returned to an adequate diet for a short period. However, these increases were found to be due to the removal of endogenous substrates which competitively inhibit in the assay and/or were insensitive to the inhibitors of protein synthesis. The changes in xanthine oxidase activity and that of two other depletable enzymes, esterase and arginase, were found to be different for each enzyme upon incubation of liver slices from protein-depleted rats under anaerobic conditions or in the presence of oxygen. Arginase appeared to hold some promise as a model for the study of protein synthesis *in vitro*. A conclusive demonstration of the biosynthesis of xanthine oxidase in rat liver preparations has not been obtained in these studies.

In an investigation of a possible direct role of lipides in protein synthesis no simple relationship between the incorporation of amino acids into lipides and incorporation into proteins was found. The lipid fraction of rat liver microsomes and microsome-free cytoplasmic fluid became labeled when incubated under suitable conditions with any one of several radioactive amino acids. When C^{14} phenylalanine served as the amino acid a large part of the radioactivity incorporated into the lipid was found chemically bound in the nonphosphatide fraction. Incorporation into lipid and into protein appeared to proceed independently and by entirely different mechanisms. Thus, incorporation of C^{14} -phenylalanine into lipid is insensitive to treatment with fluoride, p-chloromercuribenzoate, ribonuclease, lipoxidase, or the presence of a large excess of

non-radioactive phenylalanine, all of which markedly inhibit C^{14} incorporation into microsomal protein. Crotoxin (phospholipase A) also inhibits amino acid incorporation into protein but stimulates uptake by lipid. The two processes were further differentiated by the fact that incorporation into lipid does not require an added energy source. It is concluded that the incorporation of amino acids into cytoplasmic lipides does not constitute a step in the conventional pathway of amino acid incorporation into microsomal protein. Microfilm \$2.00; Xerox \$5.00. 96 pages.

THE OXIDATIVE METABOLIC PATTERN OF
NORMAL AND KETOTIC COW LIVER AS
STUDIED WITH 1- C^{14} -LABELED C_1
THROUGH C_5 ALIPHATIC ACIDS

(L. C. Card No. Mic 59-1911)

Francis Gordon Hueter, Ph.D.
University of Maryland, 1958

Supervisor: Professor J. C. Shaw

Normal and ketotic bovine liver slices were studied using a chromatographic-autoradiographic technique. Independent incubations were made with the following carboxyl-labeled aliphatic acids: formic, acetic, propionic, butyric, and valeric. During all studies, 500 mg. of liver slices (wet weight) were incubated for two hours at 39 degrees C with 25 μ M and 25 μ C of the acid being studied.

With the "normal" cow liver slices, the label from each metabolite had its own distinctive distribution pattern. Formate carbon was incorporated to the greatest extent into glucose, followed by what appear to be phosphate esters. From acetate the label was found in beta-hydroxybutyrate, glutamate and citrate. Only small amounts of label were present in glucose and lactate. Malate, aspartate and lactate contained most of the label from propionate. Beta-hydroxybutyrate and the glutamate group accounted for the bulk of the label from butyrate, with little incorporation into C_3 intermediates. The label from valerate was distributed widely, with the greatest amounts being found in beta-hydroxybutyrate and beta-hydroxyvalerate. The total radioactivity in the non-volatile fraction subjected to chromatography was much lower from acetate than from the other acids.

Chromatographic analyses from ketotic cow liver incubations indicated some major metabolic differences from normal. The details of these chromatographic differences are discussed. In general, the liver incubations indicated that as the severity of the ketotic syndrome increased, a corresponding increased utilization of propionate and decreased utilization of acetate and butyrate occurred. In addition, a marked decrease in the oxidation and incorporation of formate was noted for the ketotic liver slices. The ketotic liver incubations also resulted in an increased production of aspartate and glutamate when formate, acetate and butyrate were substrates.

Microfilm \$2.00; Xerox \$4.00. 71 pages.

THE EFFECT OF THIOCTIC ACID ANALOGUES ON GROWTH AND PYRUVATE OXIDATION OF MICROORGANISMS

(L. C. Card No. Mic 59-1625)

William George Kelly, Ph.D.
Purdue University, 1959

Major Professor: Ralph C. Corley

An *in vivo* study has been made of the effects of several thioctic acid analogues on pyruvate oxidation in aerobically grown *E. Coli B*. The 8-methylthioctic acid and 6-ethyl-8-thiolactanoic acid were gifts of the Lederle Laboratories. Thiophene valeric acid was prepared according to the method of Cagniant (1) and 6,8-di(methylthio)octanoic acid was prepared from ethyl-6,8-dichlorooctanoate which was synthesized by the method of Reed (2). The organism was grown on a glucose-salts medium enriched by yeast extract, harvested at the end of the logarithmic growth phase, lyophilized and stored below freezing in an evacuated desiccator. The rate of oxidation of pyruvate by cells resuspended in a pH 6.5 phosphate buffer supplemented with thiamine, riboflavin, ATP and $MgSO_4$ was measured manometrically by Warburg's direct method. The rate of consumption of oxygen was found to be inversely proportional to the concentration of the inhibitor. The effect of 8-methylthioctic acid and 6-ethyl-8-thiolactanoic acid was reversed by added thioctic acid, whereas inhibition by thiophene valeric acid and 6,8-di(methylthio) octanoic acid was not competitive. Albrecht (3) has reported that 6-ethyl-8-thiolactanoic acid inhibits the transfer of the acetyl group from 6-acetyl lipoic acid to coenzyme A, but no study of the site of action of 8-methylthioctic acid has been made. The simultaneous effect of both competitive inhibitors was found to be greater than the sum of the effects of each acting separately. This observation permits the conclusion that they do not act on the same site, and thus a stepwise mechanism for pyruvate oxidation *in vivo* is implicated. Support of the cyclic mechanism postulated by Gunsalus (4) on the basis of *in vitro* studies with *E. coli* has been obtained. The evidence for this is the observation that the reversal of the inhibition by 6-ethyl-8-thiolactanoic acid by added thioctic acid is not described by classical Michaelis-Menton treatment at relatively high concentrations of 6-ethyl-8-thiolactanoic acid, but rather is characteristic of a situation in which the substrate is regenerated and the inhibitor blocks this reaction. This suggests that a cyclic mechanism is operative.

Since inhibition of pyruvate oxidation in non-proliferating *E. coli* cells by thioctic acid analogues and the reversal of this inhibition by thioctic acid are possible, it is evident that thioctic acid plays an important role in at least one pathway in the oxidative metabolism of pyruvate. From these experiments alone one cannot conclude that no other pathway exists in *E. coli*, but studies by Reed (5) on a thioctic acid requiring mutant indicate that this may be the case.

All the compounds used in this study were racemates or mixtures of all possible stereoisomers. It would be of interest to study the effects of the optically pure compounds. Stokstad has indicated that 8-methylthioctic acid contains at least one compound with thioctic acid activity, and the preparation containing all the isomers is active as a growth factor in *C. bovis* (6). Experiments on the simul-

taneous effect of 8-methylthioctic acid and 6-ethyl-8-thiolactanoic acid indicate that 8-methylthioctic acid reverses the effect of small but not large amounts of 6-ethyl-8-thiolactanoic acid. This may explain why 8-methylthioctic acid is only one-twentieth as effective as 6-ethyl-8-thiolactanoic acid. The effects of the optically pure substances would probably be qualitatively the same as the mixtures, but significant quantitative differences would be expected.

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ASPECTS OF TESTOSTERONE PRODUCTION BY THE CANINE TESTIS

(L. C. Card No. Mic 59-1753)

Norman Ronald Mason, Ph.D.
University of Utah, 1959

Chairman: Kristen Eik-Nes

Studies involving the conversion of acetate to both cholesterol and steroid hormones by endocrine tissue indicated that cholesterol might not be an obligatory intermediate in hormone biosynthesis. To retain the hypothesis that cholesterol is an obligatory intermediate, however, the concept has arisen that there may be more than one pool of cholesterol in the cell. Not all of the data can be explained in this manner, and the role of cholesterol in hormone biogenesis is still in doubt.

Intimately connected with steroid hormone biosynthesis by the testis is the action of the gonadotrophins. As yet very little is known about how they act except that it is probable that HCG* acts to increase production of testosterone by the canine testis.

It was thought that valuable information might be obtained by studying the effect of HCG on incorporation of radioactive acetate into testosterone by testis tissue. Thus, if there is any change in testosterone specific activity due to HCG action such a change ought to show up in possible precursors of the hormone such as cholesterol.

To study this problem, male mongrel dogs were obtained and preinjected intramuscularly with HCG several days before the experiments to raise the testosterone production by the testis to measurable concentrations. The spermatic cords were isolated below the *ligamentum inguinale* and a tapering cannula inserted connecting the femoral artery to the spermatic artery on each side of the animal. Acetate was infused via this cannula. The spermatic vein on the left side was then cannulated and blood

samples collected for periods of time before and after the injection of HCG into the left arterial cannula. At the end of the experiment, the testes were removed for cholesterol analysis.

Testosterone was isolated by extraction of the spermatic vein plasma, precipitation of fat and chromatography, and the radioactivity and amount of testosterone determined on paper strips by scanning methods. Cholesterol was purified by extraction and digitonin precipitation. Radioactivity of the sterol was determined by plating and the amount determined by the Zak color reaction.

It was found that HCG caused an increase in testosterone output within fifteen minutes after introduction into the blood supply of the testis if the level is not already high. HCG caused an equally prompt increase in incorporation of acetate carbon into testosterone if there had been significant production of testosterone during the period before the intravenous injection of the tropic hormone. There would, therefore, appear to be a pool of intermediates, but the pool size must be quite small. The influence of HCG was not through an influence on blood flow but directly on secretion.

HCG affects some step in testosterone synthesis which is before the limiting step, since in experiments where the rate of testosterone output was not further increased the specific activity was raised by the injection of the gonadotrophin. It was suggested that the rate limiting step was at least before pregnenolone in the postulated biosynthetic sequence leading to testosterone.

The specific activities of the digitonin precipitable material from the various intracellular fractions studied do not show variations which are related to HCG action. Either there is a pathway of synthesis not involving these, or the size of the pool of digitonin precipitable intermediates is a very small part of any of the fractions measured.

Microfilm \$2.00; Xerox \$5.80. 117 pages.

*HCG: Human Chorionic Gonadotrophin

STUDIES ON THE INTRACELLULAR STATUS AND LOCALIZATION OF MOUSE PANCREAS RIBONUCLEASES

(Publication No. 21,509)

Gene A. Morrill, Ph.D.
University of Utah, 1959

Chairman: Sherman R. Dickman

The purpose of the present investigation has been to obtain information on the intracellular status, localization, and function of an enzyme. These studies have been performed on mouse pancreatic ribonuclease, an enzyme responsible for the hydrolytic cleavage of ribose nucleic acid.

The evidence presented in this thesis indicates that mouse pancreas ribonuclease and beef pancreas ribonuclease have quite similar catalytic properties. Both enzymes cause a partial breakdown of RNA and split only secondary phosphate esters of pyrimidine-3'-phosphates. Further, both enzymes have similar pH optima and general stability to storage and handling.

Mouse pancreas ribonuclease can be chromatographed on columns of the carboxylic ion exchange resin IRC-50 (XE-64). When 0.2 M sodium phosphate buffer, pH 6.47, extracts of mouse pancreas are prepared and chromatographed, the enzymatically active material was eluted in two broad zones. However, when 0.25 N sulfuric acid extracts of mouse pancreas are chromatographed, two sharp, distinct peaks of ribonuclease activity can be recognized, indicating that an alteration of the protein molecule occurred during the acid treatment. pH 7.5:5.0 ribonuclease activity ratios for the individual fractions indicate an enzymatic as well as chromatographic heterogeneity both within a given peak as well as between the peaks from a sulfuric acid extract of mouse pancreas. These chromatographic elution components have been further studied by limited rechromatography and under conditions of pH gradient elution.

The intracellular distribution of the ribonucleases of mouse pancreas was studied by differential centrifugation of pancreas homogenates prepared in 0.25 M sucrose. Approximately 70 per cent of the ribonuclease activity in the tissue was associated with three (of one nuclear and nine cytoplasmic) isolated cell fractions. The highest level of ribonuclease activity was found in the "cytoplasmic f" microsomal fraction (35 per cent), with lesser amounts being found in the nuclear dense granule fraction (20 per cent) and the cell "soluble" or supernatant fraction (15 per cent).

The effect of treating the nuclear and cytoplasmic pellets isolated from mouse pancreas homogenates with 0.25 N sulfuric acid by the method of Hirs et al. was studied. Large decreases in the activity of the nuclear fraction as well as moderate increases in the "cytoplasmic f" microsomal fraction was observed, and the significance of these changes are discussed.

The cell supernatant contained a significant level of ribonuclease activity when the tissue was homogenized in sucrose, and this level could be increased four or five fold by treatment with a strong acid or by column chromatography. This inactive or latent ribonuclease may be bound to a protein inhibitor which is removed by an acid-inactivation or by chromatography. The relationships of these findings to other studies on cellular enzyme inhibitors are discussed.

Chromatographic elution studies were carried out on both the 0.2 M sodium phosphate buffer extracts and the 0.25 N sulfuric acid extracts of four ribonuclease "rich" cell fractions. Differential analyses of the elution patterns from these cell fractions indicate, based on stability or lability to acid treatment and intracellular localization, that at least six distinct forms of the enzyme may be present in the 0.2 M sodium phosphate buffer extracts of mouse pancreas. Further, two of the six ribonucleases have specific intracellular locations, and only one of the six enzymes appears to be present in each of the fractions investigated.

Mouse pancreas has been incubated *in vitro* with a parasympathomimetic drug (pilocarpine) and with the hormone pancreozymin. Secretion (active extrusion) of both amylase and ribonuclease and an increase in respiratory rate occurred during incubation. Large differences in both the stimulated and non-stimulated extrusion of enzyme were found in different strains of mice. The means of killing the animals and pre-treatment of the tissue also affected secretion.

Chromatographic analyses of the ribonuclease "actively extruded" into the incubation medium by maximal *in vitro* stimulation with pilocarpine or pancreozymin suggests the following hypothesis:

The enzyme associated with the nuclear fraction is contained in dense secretory granules which are selectively released on *in vitro* pilocarpine stimulation. In contrast, a less dense secretory granule, present in the so-called "principle zymogen fraction" of the cell, is selectively released by *in vitro* pancreozymin stimulation. In addition, the appearance of very large amounts of ninhydrin positive material (normally present almost exclusively in the soluble portion of the cell) in the incubation medium further suggests an involvement of the cellular cytoplasm in the secretory mechanism.

The cytochemical implications of the intracellular status and function of mouse pancreatic ribonuclease and the relationships of these findings to previous studies on cellular ribonucleases are discussed.

Microfilm \$2.30; Xerox \$8.00. 173 pages. Mic 59-2786.

DEGRADATION OF CELLULOSE BY A THERMOPHILIC MICROORGANISM OBTAINED FROM COMPOSTING GARBAGE

(L. C. Card No. Mic 59-1072)

Bernard Newman, Ph.D.
New York University, 1956

Adviser: William T. Ingram

A thermophilic sporeforming bacillus was isolated from composting garbage and was found to digest cellulose quite rapidly at temperatures above 45°C. The metabolic pathway for cellulose digestion was found to be via cellobiose and galactose, apparently by virtue of a Waldenase system. This was shown by Warburg studies of oxygen uptake by the organism with glucose, galactose, cellobiose, cellulose and glucose-1-phosphate as substrates. Quantitative studies were also made of the fermentation products, utilizing cellulose and glucose as substrates at different levels, and comparisons were made of the distributions of metabolized carbon as CO₂, acids, and neutral products.

The growth curve and redox potentials relative to that found at zero time were plotted. The generation time of the organism at 56°C was found to be 17 minutes.

Microfilm \$2.00; Xerox \$4.20. 76 pages.

STUDIES ON THE STRUCTURE AND METHYLATION OF WHEAT GLUTENIN

(L. C. Card No. Mic 59-1634)

Dale LaVern Oxender, Ph.D.
Purdue University, 1959

Major Professor: Dr. H. C. Reitz

Part A

The chemistry of the action of dimethylsulfate in acid medium on glutenin was studied using model compounds to determine the sites of methylation. Amines, carboxylic acids, and polyhydroxy compounds which contain only one group common to the functional groups in proteins were used. Only the amines and carboxylic acids were methylated.

The action of POCl₃ and methanol, which are components of the methylation mixture, has been elucidated by substituting various organic solvents in the procedure. The POCl₃ serves as an acid catalyst for the esterification of the carboxyl groups in the methanol medium. A typical methylated glutenin contained 3.0 percent methoxyl, 1.2 percent methylimide and absorbs 375 times its own weight of water to form a firm gel.

Methylated glutenin was prepared using other specific acid catalyzed esterification procedures and found to be quite similar to the methylated glutenin prepared from dimethylsulfate.

From these results and data obtained in a simultaneous study of the structure of glutenin, the gelation of the methylated glutenin seems to stem from a weakening of the electrostatic bonds which, in turn, is caused by the esterification of the carboxyl groups during the methylation procedure. The fibrous protein swells upon methylation due to the net increase in positively charged groups and thus allows water to enter into its hydrophilic center.

Part B

Glutenin was prepared using a combination of the most recent methods. The glutenin as prepared contained 2.4 percent carbohydrate, 0.35 percent phosphorous and lipid substances.

Acidic solvent systems were found to disperse glutenin in aggregates while basic systems gave irreversible chemical changes in the molecularly dispersed glutenin.

The fatty acids of the phospholipids were analyzed by gas chromatography and found to be comprised of about 70.48 percent linoleic, 16.7 percent palmitic, 6.87 percent oleic, 3.28 percent linolenic, and 1.02 percent stearic, plus a small amount of other fatty acids of both higher and lower molecular weight.

The fractionation of glutenin was accomplished by dispersing it in pH 11 aqueous NaOH solution and centrifuging it at 15,000 r.p.m. for 30 minutes. The glutenin gave two insoluble fractions and one soluble fraction. The heaviest insoluble fraction accounted for 5 percent of the glutenin and proved to be starch. The remaining insoluble fraction comprising 7 percent of the original sample was found to contain 15 percent carbohydrate, 0.73 percent phosphorous and 12.17 percent nitrogen. This corresponds to 68-70 percent protein, and 17 percent phospholipid if the nitrogen and phosphorous are only in the form of protein and phospholipids, respectively. The soluble fraction, accounting

for about 80-85 percent of the glutenin, was subjected to sedimentation analysis in a Spinco Model E ultracentrifuge. These results showed the presence of three protein components.

The weight average molecular weights of these components were determined using Erlander and Foster's method for two component systems. The fast sedimenting component comprising about 48 percent of the soluble portion gave a weight average molecular weight of 410,400. The two slower sedimenting components which did not completely separate from each other were treated as one component and had an average molecular weight of 16,300.

On the basis of data obtained in this investigation and reference to several proposed structures in the literature, a structure for glutenin is presented and discussed.

Microfilm \$2.00; Xerox \$6.00. 123 pages.

INTESTINAL ABSORPTION OF METHIONINE AND HISTIDINE BY THE CHICKEN

(L. C. Card No. Mic 59-1822)

Clair Maynard Paine, Ph.D.
Rutgers University, 1959

Major Professor: M. W. Taylor

The intestinal absorption of L-, D-, and DL-methionine, and of L- and D-histidine was examined by perfusing solutions of these amino acids through the surgically prepared Thiry-Vella fistulas of adult chickens. Disappearance of administered amino acid was adopted as a measure of absorption. During the perfusions, control of temperature and of flow rate were maintained.

When 0.7 millimolar solutions of the amino acids were perfused for one hour, the L isomers of both methionine and histidine were absorbed to a greater extent than were the corresponding D isomers. The rate of DL-methionine absorption lay approximately midway between the absorption rates of its individual components. Both L- and D-methionine were absorbed more rapidly than were the corresponding isomers of histidine, at the 0.7 millimolar level. The absorption rate of L-methionine, at a concentration of 0.7 millimolar, was diminished in the presence of 1.0 millimolar 2,4-dinitrophenol. Apparently both methionine and histidine are absorbed from the chicken intestine by an optically specific process, and optimum absorption of L-methionine requires energy from respiration.

Solutions containing combinations of L- or D-methionine with L-histidine, each amino acid at a concentration of 5.0 millimolar, were circulated through Thiry-Vella fistulas for 15 minutes. The absorption of L-methionine was apparently slowed by the simultaneous presence of L-histidine, and L-histidine absorption was similarly slowed by either L- or D-methionine. These results furnish further evidence for the role of active transport in the absorption of at least the L forms of these amino acids. A saturable absorption mechanism common to both L-methionine and L-histidine is suggested. D-methionine appears capable of participating in at least one early phase of the mechanism, but it is uncertain whether D-methionine may be actively absorbed.

No conversion of D-methionine to the L form within the

Thiry-Vella fistula could be detected by the use of optically specific amino acid oxidases in manometric assays. Nor was D-methionine measurably racemized during absorption from ligated loops of chicken intestine, as indicated by similar assay procedures.

Solutions of L-methionine labeled with carbon¹⁴ in the methyl group were perfused through chicken Thiry-Vella fistulas and the components of the recovered solutions separated by paper chromatography. All radioactivity present on the chromatograms after development appeared to be due to the presence of unabsorbed methionine. This was believed to demonstrate the absence of transformations within the intestine leading to apparent losses of methionine, and to show that there was no evidence for the accumulation of an intermediate structure within the intestine as a precursory step to L-methionine absorption.

Microfilm \$2.00; Xerox \$5.80. 118 pages.

THE SEPARATION AND PROPERTIES OF UNKNOWN CAROTENOIDS FROM THE CORN ENDOSPERM

(L. C. Card No. Mic 59-1636)

Edgar Neiman Petzold, Ph.D.
Purdue University, 1959

Major Professor: F. W. Quackenbush

The greater portion of the experiment work presented herein was directed toward a study of the provitamin A, physical and chemical properties of two uncharacterized carotenes and one carotenol. For their preparation, Xanthophyll Oil was used as a source of corn endosperm lipids. The oil was passed through an aluminum oxide column and treated with methanolic KOH to remove saponifiable materials. Large amounts of colorless substances were removed by crystallization. The carotenoid pigments were separated on magnesium oxide into polyene, carotene, lower carotenol, upper carotenol and carotenediol fractions.

Two uncharacterized carotenes named " α -zeacarotene" and " β -zeacarotene" were prepared from the carotene fraction by initially separating them from β -carotene and γ -carotene on an aluminum oxide column and then from each other on lime-Super Cel columns. α -Zearotene differed from β -zeacarotene by its lower adsorptive affinity on three different adsorbents and its spectral inflections in hexane which were shifted about 4 m μ toward shorter wavelengths. Iodine isomerization experiments showed that these two carotenes are not stereoisomers of each other or of known carotenoids. Although α -zeacarotene did not show any provitamin A activity, two isomers of β -zeacarotene were 26% and 15% as active as β -carotene. Comparison of their properties with other isoprenoids shows that α -zeacarotene and β -zeacarotene have 8 and 9 conjugated double bonds respectively. The properties of dehydrogenated derivatives obtained by treating these pigments with N-bromosuccinimide suggest that α -zeacarotene and β -zeacarotene may be dihydro- δ -carotene and dihydro- γ -carotene respectively.

A γ -carotene fraction appeared on aluminum oxide as a light yellow zone which adsorbed as the uppermost part of the carotene fraction. When this fraction was

rechromatographed on the same adsorbent, two zones were observed but were difficult to separate. The lower zone, ζ_1 -carotene, crystallized readily (m.p. 72-74°C.) and appeared to be relatively stable. The upper zone (ζ_2 -carotene) had the characteristic lability similar to that found with ζ -carotene from other natural sources. ζ_2 -carotene could be crystallized (m.p. 28-31°C.) only when manipulations were made at a low temperature (-18°C.) and in the presence of a small amount of hydroquinone. Both isomers had spectra indicative of ζ -carotene previously reported, but ζ_1 -carotene had higher absorptivities.

A chromatographic method was proposed for separating a mixture of authentic acetone-2,4-dinitrophenylhydrazone, levulinic aldehyde-2,4-dinitrophenyl-bis-hydrazone, methylglyoxal-2,4-dinitrophenyllosazone and glyoxal-2,4-dinitrophenyllosazone. The quantities of these derivatives were calculated from absorptivities and absorbancies at their maximum wavelengths in 10% pyridine in ethyl acetate. When this method was applied to microozonolysis of ζ -carotene, α -zeacarotene and β -zeacarotene, the 2,4-dinitrophenylhydrazone derivatives of levulinic aldehyde, methylglyoxal and glyoxal were identified. However, many other unidentified zones were observed and low yields were obtained. Undoubtedly, more work is needed on the conditions of carotene ozonization and/or ozonide reduction. It is suggested that this method be used for such a study.

Microfilm \$2.00; Xerox \$4.60. 86 pages.

THE EFFECT OF AGE ON THE PROTEIN AND LYSINE REQUIREMENT OF THE RAT

(L. C. Card No. Mic 59-2051)

Tara Rao, Ph.D.
University of Illinois, 1959

The objective of the present thesis was to investigate the effect of age on the protein and lysine requirement of male albino rats.

First, the effect of age on the body weight gain and the nitrogen, lysine and tryptophan deposition in rats fed an adequate diet was determined. The purpose of this study was to arrive at the net lysine requirement of the different age groups. The amino acid requirement could be computed from the daily gain of lysine obtained from the carcass analysis at any age, superimposed by a lysine requirement for maintenance. The lysine requirement for rats of different ages assessed in this manner were compared with the lysine requirement obtained from the nitrogen balance experiment. The effect of age on the N, lysine and tryptophan content of rats of varying ages fed an adequate diet was seen to be negligible, with average figures of 3.24%, 1.47%, and 0.17% for N, lysine and tryptophan, respectively.

Expressed as grams of amino acid/16 g N, average values of 7.56 g and 0.83 g were obtained for lysine and tryptophan, respectively. The carcass L/T ratio was found to be 9.27:1. The carcass N, lysine and tryptophan were seen to increase 6:6, 6:6, and 6:3 times their initial amount. Equations of the type $W = A - be^{-kt}$ were fitted to be the above data. A significant curvilinear relationship was seen to exist between age and body weight gain, body N, body lysine, and body tryptophan. Good agreement was

found to exist between the factorial method of estimating the lysine requirement from carcass analysis and the NB technique of estimating the lysine requirement. They were found to be 5.00 and 5.42%, 4.4 and 4.21%, 3.8 and 3.10%, and 3.4 and 2.18% for rats of average weight of 103, 201, 312 and 354 g, respectively.

The second approach was to determine the minimum N level that would give maximum NB in rats of selected age groups. The minimum levels of N that would support maximum NB in rats of average weight of 89 g and 272 g, fed an amino acid mixture simulating casein was found to be 2.35% and 1.89% N, or 14.69% and 11.81% protein. The minimum N level that would give maximum NB was not established validly for rats of average weight of 191 or 308 g, as the highest level of dietary N gave the best balance. However, the nitrogen levels chosen for the following experiments were 2.14 and 1.30% N, in order that the requirement should not be overshoot, but at the same time to assure good growth.

The third and last approach was to fix the lysine requirement, by determining the minimum level of lysine that would give the maximum NB, at the optimum N level, for rats of a selected age group (as determined from the previous experiment). The lysine requirement was estimated to be 0.87, 0.56, 0.33 and 0.18% at N levels of 2.57, 2.13, 1.70 and 1.32% or 16.06, 13.31, 10.63, and 8.25% protein, for rats of average weight of 103, 201, 312 and 354 g, respectively. When the lysine requirement is expressed as a fraction of the protein level, it was found to be 5.42%, 4.21%, 3.10% and 2.18% for rats of average weight of 103, 201, 312 and 354 g, respectively. This clearly demonstrates that the lysine requirement markedly decreases with age.

Microfilm \$2.00; Xerox \$5.20. 103 pages.

THE INFLUENCE OF CULTURAL SODIUM CHLORIDE CONCENTRATION ON GROWTH, ENZYMIC LYSABILITY AND AMINO SUGAR CONTENT OF *MICROCOCCUS LYSODEIKTICUS*

(L. C. Card No. Mic 59-1824)

Stanley Marvin Reimer, Ph.D.
Rutgers University, 1959

Major Professor: Dr. Gerald Litwack

Cultural NaCl concentration determines the velocity at which cells of *M. lysodeikticus* are lysed by lysozyme. Various levels of NaCl or other mono- or divalent ions have been employed for growth of these organisms with complex or chemically-defined media. Cells were harvested after 48 hours of growth at 28°C. Cell growth, enzymic lysability and amino sugar content were studied as functions of cultural anion and cation concentrations. The results show that the cation is responsible for the observed stimulation. Na⁺ ion was the most stimulatory cation studied. The cells were prepared by washing, extraction and drying with organic solvents. The rate of lysis by lysozyme was studied. Amino sugars in cell acid hydrolyzates were separated on Dowex-50 (H⁺) ion-exchange resin. Constituent amino sugars were identified as glucosamine and muramic acid (3-O- α -carboxyethylglucosamine) by the visual absorption spectra of their Elson-Morgan reaction

products. The dialyzable and non-dialyzable (hydrolyzed by HCl) fractions following enzymatic lysis were also subjected to chromatography. In the dialyzable fraction glucosamine was the predominant amino sugar, whereas glucosamine and muramic acid were found in the non-dialyzable fraction. Acid hydrolysis of the dialyzable fraction resulted in the identification of glucosamine and muramic acid as components of the dialyzable product. Cellular glucosamine and muramic acid were stimulated by NaCl concentrations optimal for growth, but ionic strength alone did not limit this phenomenon. Amino sugar content was proportional to cell growth and rate of lysis by lysozyme.

Cell walls were prepared by a modification of techniques currently employed for their isolation. Identification of cell walls was accomplished by electron microscopy. Similar studies on amino sugar content and enzymic lysability were extended to the cell wall preparations as well as the intact cells. It was shown that the results obtained with the cell wall are not necessarily similar to that shown with the intact cell.

Flame spectrophotometric and emission spectrographic techniques were employed for elemental analysis of the intact cell and the cell wall of *M. lysodeikticus*. Na⁺ ion was found to be deposited largely in the cell wall compared to the intact cell. Seventeen other elements were detected in the intact cell and cell wall.

The role of cultural NaCl concentration in relation to the formation of lysozyme substrate is discussed.

Microfilm \$2.00; Xerox \$5.00. 116 pages.

STUDIES ON THE BIOSYNTHESIS OF PYRIMIDINES

(L. C. Card No. Mic 59-2277)

Richard L. Stambaugh, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. D. Wright Wilson

Previous studies, conducted in this laboratory, demonstrated that 3-C¹⁴-aminofumaric acid diamide was an efficient precursor of both the nucleic acid uridylic acid and the acid-soluble uracil in rat liver slices. The purpose of this research was to confirm these results, and to establish whether orotic acid, orotamide, or L-aspartic acid are intermediates for this incorporation.

It was verified in this research that 3-C¹⁴-aminofumaric acid diamide is a precursor of the acid-soluble uracil in regenerating rat liver, or in liver from very young rats. Evidence is presented that orotic acid is not an intermediate. This conclusion is based on the observation that, although a bank of orotic acid inhibits this incorporation, the reisolated orotic acid has a lower specific activity than the acid-soluble uracil.

When a bank of orotamide or L-aspartic acid was added to the incubation with 3-C¹⁴-aminofumaric acid diamide, no significant inhibition of the incorporation of C¹⁴ into the acid-soluble uracil was observed. In addition the reisolated bank of orotamide contained no radioactivity. This indicates that neither of these two compounds are intermediates for the incorporation of 3-C¹⁴-aminofumaric acid diamide into the uracil.

Under the conditions employed, 3-C¹⁴-aminofumaric acid diamide was about 70% as efficient as 4-C¹⁴-L-aspartic acid as a precursor of the acid-soluble uracil.

Microfilm \$2.00; Xerox \$5.80. 120 pages.

STRUCTURAL STUDIES IN CERTAIN ANIMAL POLYSACCHARIDES

(L. C. Card No. Mic 59-2325)

Gordon Sutherland, Ph.D.
The Ohio State University, 1953

Polysaccharides are among the building materials of animal as well as of plant organisms. The structural studies of animal polysaccharides have been quite limited. The purpose of the dissertation was to extend the knowledge of three of these important polysaccharide materials.

One polysaccharide was pneumogalactan, a polygalactose, which has been isolated from beef lung.^{1,2} Another was a mucopolysaccharide, which has been called mucoitin-sulfuric acid, a polymer composed of D-glucuronic acid and N-acetyl-D-glucosamine units partially esterified with sulfuric acid.³ The third polysaccharide, hyaluronic acid,⁴ was also a mucopolysaccharide containing a polymer of D-glucuronic acid and N-acetyl-D-glucosamine units with no prosthetic groups.

Pneumogalactan has been highly purified by the use of the following series of processes: fractional precipitation, dialysis, ion exchange resins and treatment with activated carbon.^{1,2} D-Galactose was shown to be the only constituent sugar residue present. Periodate oxidation studies indicated a consumption of four moles of oxidant per anhydro hexose unit with the formation of two moles of formic acid. The presence of three different methyl ethers of galactose in the hydrolysis products obtained from methylated pneumogalactan has been reported,⁵ but the small amount of material used made this identification questionable.

Mucoitinsulfuric acid was first isolated by Levene,³ who also established that D-glucosamine, a uronic acid, acetic acid, and sulfuric acid were liberated upon hydrolysis. The uronic acid was later identified as D-glucuronic acid.⁶ A technique for its isolation from pig gastric mucin was developed⁷ and the product characterized analytically.

Most of the work on the chemical constitution of hyaluronic acid has been done by Karl Meyer and coworkers,⁸ who isolated the polysaccharide and identified its component parts as N-acetyl-D-glucosamine and D-glucuronic acid in a 1:1 ratio. Periodate oxidation shows the uptake of 0.1 to 0.2 moles of oxidant per repeating unit with the liberation of 0.08 moles of formic acid.⁹ The attempted methylations of the polymer have not yielded a satisfactory product.¹⁰

EXPERIMENTATION

Pneumogalactan

Pneumogalactan did not form a complex with either May's copper reagent¹¹ or with borax.¹²

This galactan was converted with acetic anhydride in pyridine to its triacetate derivative. Although the usual methylation with dimethyl sulfate and sodium hydroxide was unsatisfactory, the application of the Menzies thallium

hydroxide alkylation¹³ followed by the usual Purdie methylation procedure¹⁴ produced a tri-O-methyl-pneumogalactan.

Hydrolysis of this methylated galactan and paper partition chromatography¹⁵ led to the proper identification of 2,4-di-O-methyl-D-galactose, 2,3,4-tri-O-methyl-D-galactose, and 2,3,4,6-tetra-O-methyl-D-galactose. The anilides of these compounds were prepared for additional confirmation of their identity. The structure of pneumogalactan would consist of a main chain of D-galactopyranose units 1→6, with one D-galactopyranose entity attached 1→3 on every other unit of the main chain.

Mucoitinsulfuric Acid

Mucoitinsulfuric acid was prepared by alkaline treatment of pig gastric mucosa followed by fractional precipitation.

The sulfate ester group of mucoitinsulfuric acid interferes with the elucidation of its structure. Several possible desulfation procedures were investigated; they were the action of acetic anhydride in absolute sulfuric acid,¹⁶ hydrolysis with barium hydroxide, hydrogenolysis, and trifluoroacetic anhydride promoted acetylation.¹⁷ These methods either had no effect or resulted in extensive degradation of the polysaccharide.

Methylation with methyl iodide and thallous hydroxide¹³ and silver oxide¹⁴ gave a product with a methoxyl content of 22 percent; this value represented 92 percent formation of a mucoitinsulfate mono ester.

Hyaluronic Acid

Hyaluronic acid was isolated by extraction of human umbilical cords with water, precipitated as the lead salt, liberated by treatment with potassium acid sulfate, and purified by dialysis.

An attempted methylation in liquid ammonia with sodium and methyl iodide¹⁸ was unsuccessful.

SUMMARY

1. Pneumogalactan was acetylated and methylated.
2. The methylated pneumogalactan was hydrolyzed, and the constituent methyl ethers of D-galactose were identified. This evidence permitted the proper elucidation of the structure of pneumogalactan.

3. Mucoitinsulfuric acid was isolated and methylated. Attempts at desulfation were unsuccessful.

4. A new method for the isolation of hyaluronic acid was developed; however, its methylation was unsuccessful.

Microfilm \$2.00; Xerox \$3.00. 54 pages.

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COOPERATIVE CONFORMATIONAL CHANGES IN BOVINE PLASMA ALBUMIN: I DIFFERENTIAL ULTRAVIOLET ABSORPTION SPECTRA. II OBSERVATIONS ON MOLECULAR AGGREGATION.

(L. C. Card No. Mic 59-1655)

Edward James Williams, Ph.D.
Purdue University, 1959

Major Professor: Joseph F. Foster

Bovine Plasma Albumin (BPA) exhibits a pH-dependent differential absorption spectrum with a primary absorption maximum at 287 mμ and a secondary maximum at 280 mμ. The spectrum is thus very similar in appearance to differential spectra which have been obtained for insulin and ribonuclease and also resembles the differential spectra of tyrosine, O-methyl tyrosine, glycyl O-methyl tyrosine and acetyl tyrosine ethyl ester. Large changes in the differential spectra occur in the same pH region where pronounced changes in intrinsic viscosity, specific rotation, electrophoretic mobility, and sedimentation velocity have been observed. The effect of urea and ionic strength in

addition to the effect of pH on the differential spectrum of BPA is such as to suggest that the spectrum is related to cooperative changes in the configuration of the protein molecule. Although the differential spectra of insulin and ribonuclease have been attributed to variations in the extent of intramolecular tyrosyl-carboxylate hydrogen-bonding, the results of the present investigation are interpreted from the viewpoint that factors other than hydrogen-bonding may be involved. This viewpoint is based on the postulate that conformational changes in the BPA molecule result in the transfer of tyrosyl chromophores from a protein environment to an aqueous environment. The spectrum of the tyrosyl residues are perturbed as a result of this environmental modification, the perturbation being due directly to either a loss of intramolecular tyrosyl-carboxylate hydrogen-bonding or alternatively to a change in the dielectric constant of the environment, or a change in the refractive index (electronic polarizability) of the environment. There is reason to believe that a change in the electronic polarizability of the environment may be responsible for the greater part of the spectral perturbation.

The observation that the absorption spectrum (between 320 and 400 m μ) of anthracene coupled to BPA appears to be affected by pH-induced configurational changes in the molecular structure of BPA indicates, perhaps, that the spectral perturbation is due to changes in the extent of Van der Waals interaction between the anthracene and a hydrophobic region of the protein. Since the Van der Waals interaction energy is directly proportional to the electronic polarizability of the interacting groups, this observation may be considered as tentative evidence that the absorption spectra of proteins are affected by changes in the electronic polarizability of the environment of constituent absorbing species which are present in the protein.

The percent of BPA dimer which is formed as the pH is lowered below the isoionic point is maximal in the vicinity of pH 3.3 - 3.4. The rate of dimerization is slower and the percent of dimer less when non-defatted protein is used. Moreover the dimerization process appears to be inhibited by the presence of ethylenediaminetetracetic acid (EDTA) although the inhibitory action does not seem to be due to the chelation by EDTA of trace quantities of metal impurities. Ascorbic acid and stearic acid were not observed to inhibit the dimerization. Experiments indicate that the dimer in a solution which has stood for two days or longer at room temperature can be reconverted to monomer by prolonged dialysis against a low pH (<2) solution or by dialysis against a 0.01 M cysteine solution (pH = 3.4). However, the extent of reversion is insignificant when such a solution is dialyzed for a similar period against solutions ranging in pH from 4 to 7. Dialysis for two to three days against EDTA or cysteine also does not reverse dimerization. It appears that the mechanism of dimerization is complex and undoubtedly involves the interplay of electrostatic repulsive forces and probably the conversion of BPA from its native form (containing bound fatty acid) to one which readily undergoes aggregation (defatted BPA). Although the mechanism by which dimerization occurs may involve an intermolecular thiol-disulfide exchange reaction, secondary hydrophobic or electrostatic bonds presumably help to stabilize the dimer.

Microfilm \$2.00; Xerox \$5.00. 98 pages.

CHEMISTRY, INORGANIC

THE SYNTHESIS AND PROPERTIES OF COMPOUNDS CONTAINING A SILICON-PHOSPHORUS BOND. THE REACTION OF SODIUM WITH DECABORANE.

(L. C. Card No. Mic 59-2221)

George Everett Bagley, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. E. Charles Evers

Appreciable quantities of bis-trimethylsilylphosphine are prepared by the reaction of trimethylchlorosilane with dilithium hydrogen phosphide in anhydrous ether at room temperature. $((\text{CH}_3)_3\text{Si})_2\text{PH}$ is a colorless liquid which melts at about -35° and boils at 166°C . On standing, the product disproportionates slowly at -78° and at an appreciable rate at room temperature to form $(\text{CH}_3)_3\text{SiPH}_2$ and $((\text{CH}_3)_3\text{Si})_3\text{P}$. The compound reacts with B_2H_6 to form $((\text{CH}_3)_3\text{Si})_2\text{PH}:\text{BH}_3$ which gives off $(\text{CH}_3)_3\text{SiH}$ on standing and forms polymeric $(\text{CH}_3)_3\text{SiP(H)BH}_2$, a clear glassy solid. Heating of this polymer in one experiment caused the evolution of H_2 and CH_4 with the formation of a dark solid polymer having an atom ratio Si:P:B of 0.8:1.0:1.1. $((\text{CH}_3)_3\text{Si})_2\text{PH}$ reacts with one equivalent of Na in liquid ammonia forming $((\text{CH}_3)_3\text{Si})_2\text{P-Na}$. This white solid reacts with CH_3I in liquid ammonia to give $((\text{CH}_3)_3\text{Si})_2\text{P-CH}_3$ and NaI.

The Li_2PH used in the above reaction is prepared by treating Li metal with PH_3 in liquid ammonia. When the excess NH_3 is allowed to blow off at room temperature, there remains white solid $\text{LiPH}_2 \cdot 4\text{NH}_3$. When this solid is pumped at room temperature, or even at 0° , there is a simultaneous evolution of NH_3 and PH_3 with the subsequent formation of light orange solid Li_2PH .

Silylphosphine, H_3SiPH_2 , is formed by reacting SiH_4 and PH_3 . An adduct of the composition $\text{H}_3\text{SiPH}_2:\text{BH}_3$ is formed by condensing diborane and silylphosphine together. The adduct is solid at -78° , melts below 0° , and is completely dissociated in the vapor state at room temperature. On standing at room temperature, the substance decomposes slowly yielding a solid residue together with silane, phosphine, diborane, and hydrogen.

Unsuccessful attempts to prepare compounds containing a silicon-phosphorous bond by reacting halosilanes with elemental phosphorus and by dehydrohalogenation reactions are also described.

When decaborane is recovered from solution in liquid ammonia, the solid phase retains a considerable amount of ammonia, which apparently may be removed continuously on continued suction. X-ray powder diagrams of substances of the composition $\text{B}_{10}\text{H}_{14} \cdot 4\text{NH}_3$ and $\text{B}_{10}\text{H}_{14} \cdot \text{NH}_3$ were significantly different and differed from $\text{B}_{10}\text{H}_{14}$ itself. This suggests the existence of solvents of definite proportions, but it is not definite proof of their existence.

In liquid ammonia solution two gram atoms of sodium react with one mole of decaborane. In reactions employing one g. atom of sodium per mole of decaborane x-ray powder diagrams indicate the presence of unreacted hydride, but here there are no lines due to the sodium compound. This means that the sodium compound produced here is amorphous or microcrystalline; but it does suggest that two atoms of sodium combine with one molecule of

decaborane as shown by chemical evidence. X-ray powder diagrams of reactions carried to the blue end-point show a fairly reproducible pattern to be ascribed to a disodium compound, but the amount of background scattering suggests the presence of an amorphous phase in addition to crystalline material. Solutions of decaborane also react with sodium amide; the x-ray powder diagram of the product obtained on treating one mole of amide with one mole of hydride showed the presence of decaborane and of a crystalline phase similar to those produced above using two equivalents of sodium.

Microfilm \$2.00; Xerox \$5.40. 110 pages.

**ULTRAVIOLET SPECTRA AND FERROINE
REACTION OF BIPYRIDINES AND PYRIDYL
SUBSTITUTED s-TRIAZINES**

(L. C. Card No. Mic 59-2412)

Edward Bracy Buchanan Jr., Ph.D.
Iowa State College, 1959

Supervisor: Harvey Diehl

A new series of compounds, the pyridyl substituted s-triazines, has been found to yield colored compounds with iron(II). The molar absorptivity of the iron derivatives has been found to increase as the number of the pyridine rings attached to the central triazine ring increases. Thus the molar absorptivity of the iron(II) derivative of 2,4-diamino-6-(2'-pyridyl)-s-triazine was found to be 300, while that of the 2-amino-4,6-bis(2'-pyridyl)-s-triazine is 8,000 and that of the tris(2'-pyridyl)-s-triazine is 23,000. Inasmuch as the latter compound has a sensitivity approaching that of bathophenanthroline and as it is much easier to produce it should become the preferred reagent for the colorimetric determination of traces of iron.

The compounds tris-(2,4-diamino-6-(2'-pyridyl)-s-triazine iron(II) chloride and bis-(2-amino-4,6-bis-(2'-pyridyl)-s-triazine iron(II) perchlorate have been prepared in a crystalline state. The composition of the former has been inferred from data obtained by the method of continuous variations applied to solutions of this compound. The composition of the latter was determined by three different methods. The method of continuous variations, spectrophotometric titrations and finally a direct analysis was performed. The results of all three methods confirmed the above formula.

The absorption spectra of pyridyl substituted s-triazines and their iron derivatives were found to resemble closely those of the analogous polypyridyl compounds. The members of both series have two absorption bands in the ultraviolet. It has been shown that these bands arise from a cross conjugated structure of either a para-para or an ortho-para quinoid type excited state.

As the ultraviolet absorption spectrum is caused by an excitation resulting in a cross conjugated structure and as the absorption bands in the ultraviolet are enhanced upon the formation of the iron(II) derivative the ligand must assume a planar configuration within the iron(II) chelate. In the case of 2-amino-4,6-bis(2'-pyridyl)-s-triazine and tris(2'-pyridyl)-s-triazine and tris(2'-pyridyl)-s-triazine, which act as tridentate ligands, the configuration of the

resultant iron chelate would have one ligand occupying positions 2,3 and 4 and the second ligand in a plane perpendicular to the plane of the first occupying positions 1, 5 and 6 of the iron coordination sphere.

Microfilm \$2.00; Xerox \$5.80. 120 pages.

**THE FUNCTION OF METAL IONS IN SOME
SOLID INORGANIC STABILIZED ARYLDIAZONIUM
SALTS OF THE DOUBLE SALT TYPE**

(L. C. Card No. Mic 59-613)

Alcuin Florian Gremillion, Ph.D.
Tulane University, 1958

Supervisor: H. B. Jonassen

Since the discovery of diazonium salts in 1858, many inorganic salts have been used to stabilize them. Numerous workers have come to regard these substances as true double salts while others view them as being diazonium salts of complex metal anions. For example, the double salt formula of a mercuric chloride stabilized diazonium chloride would be indicated by $\text{ArN}_2\text{Cl} \cdot \text{HgCl}_2$, while that of the complex metal ion form would be indicated by the formula $[\text{ArN}_2]^+ - [\text{HgCl}_3]^-$. The latter formula indicates that three halogen atoms are covalently bound to the mercury(II) ion. The formula of the double salt form indicates a distribution of the halogen atoms between those bonded to the mercury(II) ion and that bonded to the diazonium ion.

Little has been reported in the past on attempts to elucidate the mode of interaction of the stabilizing agent and the diazonium salt. This study was undertaken to determine if the inorganic stabilized diazonium salts should be regarded as diazonium salts of metal complex anions, true double salts or some other type of molecular species. It was hoped that this would help in understanding the mechanism of stabilization.

The reactivity of concentrated sulfuric acid with a variety of compounds, resulting from the stabilization of p-dimethylaminobenzenediazonium chloride with various metal chlorides and bromides, has been studied. Hydrogen chloride has been liberated from some of the reaction mixtures and has been measured. The table on the following page summarizes the results of the experiments with the metal chloride stabilized compounds. In addition to the experiments which are summarized in the table the zinc bromide and mercuric bromide stabilized p-dimethylaminobenzenediazonium chloride compounds were treated with concentrated sulfuric acid. When the zinc bromide compound was treated with the acid in an apparatus under reduced pressure (one mm. of mercury) gas was evolved. A mass spectrometer analysis of this gas showed hydrogen chloride and sulfur dioxide but no bromine. When the same reaction was attempted at atmospheric pressure the gas evolved was again analyzed by use of a mass spectrometer. Hydrogen chloride was present but only a trace of sulfur dioxide and no bromine were found. Under reduced pressure the mercuric bromide compound evolved only hydrogen chloride. At atmospheric pressure the same result was obtained. The concentrated sulfuric acid solutions obtained after the treatments of the metal chloride stabilized compounds were all colorless while the solution remaining after treatment

A TABLE OF RESULTS OF THE ACTION OF
CONCENTRATED SULFURIC ACID ON THE SOLID
METAL CHLORIDE STABILIZED COMPOUNDS

Number	Compound Treated with Concentrated Sulfuric Acid	Moles of Hydro- gen Chloride Liberated per Mole Compound
I	$(p-(C_2H_5)_2NC_6H_4N_2Cl)_2 \cdot ZnCl_2$	2
II	$p-(C_2H_5)_2NC_6H_4N_2Cl \cdot ZnCl_2 \cdot H_2O$	2
III	$p-(CH_3)_2NC_6H_4N_2Cl \cdot ZnCl_2 \cdot H_2O$	2
IV	$p-(CH_3)_2NC_6H_4N_2Cl$	1
V	$p-(CH_3)_2NC_6H_4N_2Cl \cdot CdCl_2 \cdot H_2O$	0
VI	$(p-(CH_3)_2NC_6H_4N_2Cl \cdot SnCl_4)_2 \cdot H_2O$	1
VII	$p-(CH_3)_2NC_6H_4N_2Cl \cdot HgCl_2$	1
VIII	$p-(CH_3)_2NC_6H_4N_2Cl \cdot FeCl_3$	3
IX	$p-(CH_3)_2NC_6H_4N_2Cl \cdot 2SbCl_3$	0
X	$p-(CH_3)_2NC_6H_4N_2Cl \cdot BiCl_3$	0

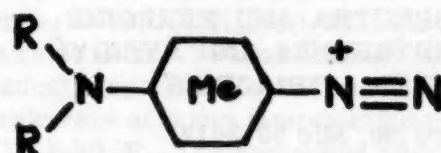
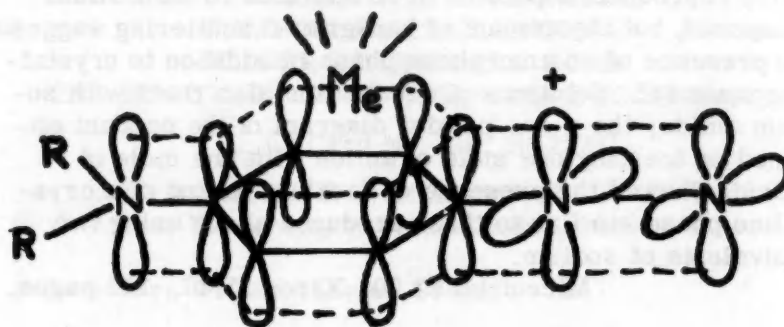
of the zinc bromide compound was brown. This indicates that bromine, formed in the reduction of some sulfuric acid, remained in solution. The solution remaining from the treatment of the mercuric bromide compound was also colorless. These experiments indicate that the halides in these compounds are not equivalent and that the covalency of the metal-halide bond affects the covalency of the diazonium ion-halide bond. It gives indication that in some cases a complex metal anion is not present.

The thermal stabilities of the compounds have been studied by measuring the rates of evolution of nitrogen from the solids at elevated temperatures. The compounds assume an order of stability which seems to be a function of the electronic configurations of the metal ions used in the various compounds. The most thermally stable compounds are those for which the metal ion has eighteen electrons in the outer shell. The least stable compound is the one having a metal ion with only thirteen electrons in the outer shell and an incomplete outer d orbital. Among the stabilized compounds, those containing antimony and bismuth are the ones whose metal ions have eighteen electrons in the (n-1) shell and two electrons in the n shell. These latter two compounds make up a group of intermediate stability and about the same as that of the unstabilized p-dimethylaminobenzenediazonium chloride. A comparison of the thermal stabilities of the zinc containing compounds indicates that the greater the amount of water present, the smaller is the thermal stability. The stabilities seem to be related to the electronegativities of the metals as the electronegativities are given on the Sanderson scale. As Sanderson's electronegativity values increase, the instability increases. The relationship between electronegativity values of the metals and the stabilities of the compounds is not perfect, but as Sanderson himself indicates, revision of some of his values may be called for.

Infrared spectra of the compounds studied show a number of interesting bands, but the most useful observation is that the 6.25 micron band breadth seems to be related to thermal stabilities. In the spectra of the two most thermally stable compounds the absorption band near 12 microns is split into a doublet. This is the band ascribed to out-of-plane wagging of ring hydrogen atoms.

Various modes of interaction between metal chloride and diazonium chloride are discussed with a charge-transfer type being favored. The data indicate a polariza-

tion of the aromatic nucleus by the metal ions. The mode of such interaction is illustrated here. The transfer of



charge is from the π cloud of the diazonium ion to the metal atom. The explanation most consistent with the results is such a charge-transfer complex in which the electronic configuration of the metal ion affects the amount of charge transfer from the aromatic ring thereby decreasing the π cloud between the ring carbon and the diazonium nitrogen.

A possible catalytic influence of the metal halides on the liberation of nitrogen from the stabilized compounds is considered. Microfilm \$2.00; Xerox \$5.40. 110 pages.

HYDROLYTIC POLYMERIZATION IN BOILED
CHROMIUM (III) SOLUTIONS: PRODUCTS
AND COURSE OF REACTION

(L. C. Card No. Mic 59-2469)

John Albert Laswick, Ph.D.
Cornell University, 1959

A method of resolving the cations present in boiled solutions of $Cr(H_2O)_6^{+3}$, based on ion exchange chromatography, is described. In addition to the monomeric hexaquo ion, which is bound least firmly to Dowex 50 cation exchange resin, two new species can be isolated. The first, easily eluted by 0.02 molar lanthanum perchlorate at pH 2, is identical to the product obtained through oxidation of chromous solutions by molecular oxygen; this has recently been identified as a dinuclear complex. The second, requiring a ten-fold increase in lanthanum concentration, is apparently more highly polymerized. Absorption spectra are given. A small residual fraction remains irreversibly sorbed on the resin.

Using the separation scheme developed, the rates of formation of the isolated ions have been followed as functions of time. In solutions originally 0.05 to 0.10 molar in $Cr(H_2O)_6^{+3}$, the dimer reaches an apparent equilibrium concentration of 11% of the total chromium within minutes at 100°; the next fraction attains a steady value of 12% only after some hours. Approximately 74% remains in monomeric form. However, very prolonged refluxing causes

deposition of nearly all of the chromium as a crystalline solid giving an x-ray pattern identical with that of HCrO_2 .

Published data on the reaction of paramolybdate ion with boiled chromic solutions are re-examined in the light of the present findings, and attempts to determine the stoichiometry of the reactions of molybdenum (VI) with the isolated polymers are described. The conductometric titrations employed exhibit a complicated time dependence, and, contrary to earlier findings, do not yield linear plots. A previously proposed mechanism for formation of the heteropoly molybdate complex of the monomeric chromic ion is criticized.

Addition of base, prior to refluxing, causes formation of a colloid and effectively prevents attainment of equilibrium. The relative merits of methods employing bases, and those used in this investigation, for systems very slow to equilibrate, are discussed.

Microfilm \$2.00; Xerox \$3.00. 54 pages.

BERYLLIUM GEOCHEMISTRY RELATED TO AGE DETERMINATION WITH BERYLLIUM-10

(L. C. Card No. Mic 59-1555)

John R. Merrill, Ph.D.
Princeton University, 1958

Adviser: Dr. James R. Arnold

Introduction: Be-10 is produced by the action of cosmic radiation on the earth's atmosphere at the rate of about 0.1 nucleus/cm²/sec. It is a beta emitter with a half-life of 2.5×10^6 years, making Be-10 potentially applicable for radioactive age determination for the past several million years. No other known natural activity is available for this period. Be-10 is eventually removed from the atmosphere by precipitation and enters the ocean. Its presence in ocean sediments, which remove and store Be, was demonstrated in 1955 by Arnold and by Peters et al. Before this nuclide can be used for age measurements in sediments, the sedimentary cycle of (stable) Be-9 must be better understood.

The Thesis: Some of the geochemical factors that will determine the conditions under which Be-10 can be employed in geochronology have been investigated.

Natural Be is a trace element. To make studies possible, a precise spectrophotometric analysis, based on the work of Adam et al., has been developed. It depends on the selectivity of acetylacetone for Be in the presence of ethylenediaminetetraacetic acid. Radioactive Be-7 is used to measure chemical yields. The limit of detection is about 0.2 microgram Be.

With this method, consecutive portions of five vertical, deep ocean sediment samples have been analyzed for Be-9. A rather uniform Be content, ranging from 2.0 to 3.0 ppm, and averaging about 2.6 ppm has been found. The samples are estimated to represent several million years of sedimentation.

In collaboration with G. Arrhenius and E. Goldberg, the chemical location of Be in sediments and some of their components has been studied in further detail. Hydrochloric acid treatment removed up to about 50% of the Be-9 from whole sediment. Treatment with ethylenediaminetet-

raacetic acid at pH 8 removed about 20%. Sediment particles in the 10 to 32 micron range contained about 2.1 ppm. The concentration increased with smaller sizes to about 3.9 ppm for particles less than one micron. The authigenic mineral phillipsite probably contains about 0.5 ppm Be. A manganese nodule was found to contain 5.0 ppm.

Far-eastern Pacific ocean water collected at three locations from a depth of 1000 meters has been analyzed for Be. Particulate Be was extracted from 50-liter samples by filtration through Millipore filters. Be in solution was removed by columns containing cation exchange resin converted to the ferric form and hydrolyzed with ammonia. Carrier-free Be-7 tracer was used to account for sample Be from the time of collection to final determinations. The ultimate analyses were performed spectrographically by N. Nachtrieb and A. Leoni at the 10^{-9} gram level. Blanks were negligible. The samples gave similar results which average: 3.9×10^{-13} ppp Be in solution and 1.8×10^{-13} ppp in particulate matter.

With the ocean and sediment data, the mean life of Be in the ocean (residence time) has been calculated in two ways as 150, and alternately, 570 years.

To estimate the residence time from the rate of supply of Be to the ocean, spectrophotometric analyses were performed on samples of the Delaware and Hudson rivers. Particulate Be was again removed by Millipore filters. Solution Be was removed by cation exchange columns. Radioactive tracer was used as in the ocean analyses. The average total Be concentrations found were 5.7 (lower Delaware), 0.2 (upper Delaware), and 0.5 (Hudson) $\times 10^{-10}$ ppp. Residence time computed with these values ranges from 30 to 1300 years.

It is concluded that the residence time must be of the same order of magnitude as the estimated ocean mixing time (several centuries). Inhomogeneity of the Be isotopes in the ocean thus appears likely. This will preclude a simple model for Be-10 age determination.

Microfilm \$2.00; Xerox \$5.00. 97 pages.

SOLUTION CALORIMETRY: I. THE COMPLEXING OF NICKEL(II) ION BY AMMONIA AND METHYLAMINE; II. THE MIXING OF HYDROGEN AND POTASSIUM POLYSTYRENE SULFONATE RESINATES.

(L. C. Card No. Mic 59-2370)

John Lawrence Schultz, Ph.D.
University of Minnesota, 1959

I. The Complexing of Nickel(II) Ion by Ammonia.

The heats of formation of nickel-ammonia complexes were measured in a calorimeter, consisting of a Dewar flask with copper resistance thermometer and manganin resistance heater. Nickel nitrate solution was contained in a glass ampoule which could be broken against the Dewar flask.

The formation constants used were those of Bjerrum¹ and Wormser.² (NH_3/Ni) ratios were chosen to give integral and half-integral values of \bar{n} from 0.5 to 5.5 and the distribution of nickel among the complexed species was determined for each experiment by combining results of

NH₃ analysis with fractional forms calculated from the formation constants.

The heat and distribution data were treated by a least squares method to give the following stepwise formation heats:

Bjerrum Distribution	Wormser Distribution
$\Delta H_1 = -4.01$ kcal/mol	
$\Delta H_2 = -3.58$	$\Delta H_2 = -7.85$ kcal/mol
$\Delta H_3 = -4.50$	
$\Delta H_4 = -3.12$	$\Delta H_4 = -7.25$
$\Delta H_5 = -2.97$	
$\Delta H_6 = -4.40$	$\Delta H_6 = -5.60$

When these derived heats were substituted back into the experimental distribution data, it was found that the two sets gave equally good agreement with the experimental heats. It was therefore concluded that the three Wormser constants, calculated on the assumption of three species containing 2, 4, and 6 NH₃, fit the Ni-NH₃ complex formation data as well as do Bjerrum's six constants, calculated on the assumption of stepwise formation of six ammoniated species.

II. The Complexing of Nickel(II) Ion by Methylamine.

It was desired to check the following data of Calvin³ on the formation of Ni(CH₃NH₂)₆⁺⁺:

$$\Delta H = +9.7 \text{ kcal/mol}$$

$$\Delta S = +73 \text{ e.u.}$$

which were calculated from temperature dependence of the equilibrium constant.

Measurements were made in the calorimeter used for the NiNH₃ system. The free [CH₃NH₂] was about 1.6 M and the ratio (CH₃NH₂/Ni) ranged from 59 to 117. Assuming that \bar{n} was about 5.5 (estimated from constants given by Calvin³), the following overall heat and entropy of formation were estimated:

$$\Delta H = -15 \text{ kcal/mol}$$

$$\Delta S = -10 \text{ e.u.}$$

These results, quite different from Calvin's, appear more reasonable in comparison with those for the Ni-NH₃ system.

III. The Mixing of Hydrogen and Potassium Dowex 50 Resinates.

The heats of mixing of hydrogen and potassium Dowex 50 X4, X8, and X12 resinates were measured in a three-chambered calorimeter. Two sample bulbs held resin samples; the external solution consisted of 0.01 M HCl-KCl mixtures whose composition did not change on equilibration with the resins.

The mixing heats ΔH° were as follows:

Resin	Mole % H Resin	ΔH° (cal/mol)
X4	25	-43
X4	50	-66
X4	75	-42
X8	25	-180
X8	50	-184

(Continued)

Resin	Mol % H Resin	ΔH° (cal/mol)
X8	75	-130
X12	25	-220
X12	50	-289
X12	76	-198

Partial equivalent free energies, enthalpies, and entropies were calculated from these results and from available equilibrium constants^{4,5}. These data indicate that both sites exceptionally favorable for potassium ions as postulated by Myers and Boyd,⁶ and sites accessible only to hydrogen ions, as postulated by Reichenberg and McCauley,⁷ exist in the resins.

Measurement of Temperature and Heat Capacity.

Temperature changes were measured to 0.0001°C with a copper resistance thermometer and a Mueller resistance bridge.

The calorimeter was calibrated electrically for each run. Heating time was measured to 0.01 second with a precision timer, and heating current to 1 part in 10,000 with a White double potentiometer.

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AN INSTRUMENTAL METHOD FOR MEASURING FLUORESCENCE AND A STUDY OF FLUORESCENT RUTHENIUM POLYAMINE COMPLEXES

(L. C. Card No. Mic 59-1653)

Hans Veening, Ph.D.
Purdue University, 1959

Major Professor: Warren W. Brandt

Adaptation and Operation of the Perkin-Elmer Spectracord as a Spectrofluorescimeter.

The Perkin-Elmer Spectracord was successfully adapted for use as a recording spectrofluorescimeter. Fluorescing systems were activated with monochromatic energy from a 6000 watt xenon arc, and the fluorescence was analyzed utilizing the optics of the Spectracord. A method for automatically recording activation spectra for strongly fluorescing systems was developed. The effect of spectral response of the detector on the wavelength maxima was determined and in the region of 500 to 600 mμ a semi-quantitative correction of +1 to +5 mμ was applied. The

electronic gain of the instrument proved to be an important factor in attaining reproducibility. Evidence was obtained to show that the intensity of the xenon arc was stable over prolonged time periods. The performance of the instrument as a spectrofluorescimeter was shown to be satisfactory by comparison to published results, obtained for similar instruments. As little as 0.02 $\mu\text{g./ml.}$ of quinine could be detected.

Fluorescent Ruthenium Polyamine Chelates.

Several polyamine chelates of ruthenium(II) were prepared. Six of these were found to fluoresce in the region 575-585 $\text{m}\mu$, and those that fluoresced were examined for fluorescence and activation characteristics. The 5-methyl-phenanthroline complex of ruthenium(II) displayed the strongest fluorescence of all tested chelates. From the standpoint of trace detectability and analytical utility, the tris-5-methyl derivative was shown to be the most effective. Excess reagent and pH were shown to cause no effect on the fluorescence of the chelate. It was demonstrated that benzyl alcohol is an effective medium in which to measure the fluorescence of $\text{Ru(5-Me-phen)}_3^{++}$, and that as little as .05 p.p.m. of ruthenium could be detected therein. Benzyl alcohol promoted the fluorescence intensity of the complex by a factor of two.

The ability of ruthenium(II) chelates to fluoresce was shown to be in accordance with their stability. Iron and osmium chelates of the same type were non-fluorescent.

A Fluorescetric Determination of Ruthenium in the Presence of Osmium.

One of the most serious interferences in ruthenium determinations is osmium. The two elements may be separated by distillation. In this work a fluorescetric method for determining ruthenium in the presence of osmium in aqueous solution is presented. The ruthenium is measured as the bivalent tris-5-methyl-phenanthroline complex. A plot of fluorescence intensity versus concentration showed a linear relationship between 0.3 and 2.0 p.p.m. ruthenium on the Spectracord. As much as 28 p.p.m. of osmium(III) can be present without interfering with the fluorescence intensity. A series of synthetic mixtures of ruthenium and osmium was run, and results showed that ruthenium could be measured with a relative percent error $\pm 1.9\%$. Serious interferences are iron(II), palladium(II), cerium(IV), manganese(II), chromium(III), permanganate, silver, and dichromate. The method has a significant advantage in that osmium and most of the platinum metals normally associated with ruthenium do not interfere.

Microfilm \$2.40; Xerox \$8.40. 182 pages.

STABILITY AND THERMOCHEMICAL STUDIES OF THE COMPLEX IONS FORMED BETWEEN TETRAETHYLENEPENTAMINE AND THE BIVALENT IONS OF NICKEL, IRON AND MANGANESE

(L. C. Card No. Mic 59-662)

Lowell Westerman, Ph.D.
Tulane University, 1958

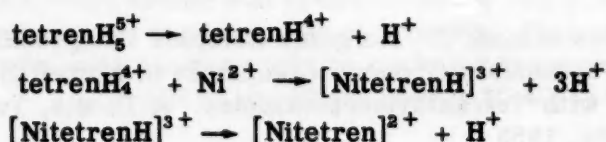
Chairman: Hans B. Jonassen

Previous investigations (1) on the nature of the complex ions formed between tetraethylenepentamine (tetren) and the nickel (II) ion have indicated that in addition to the $[\text{Ni-tetren}]^{2+}$ ion, other complex ions are present in aqueous solution at higher hydrogen ion concentrations.

Schwarzenbach (2) has pointed out that "hydrogen complexes" (complexes formed by adding one or more protons to the polyamine(s) coordinated to the metal ion) also must be considered in addition to the simple MZ_x type, where Z is the polyamine and x equals 1, 2, 3, . . . n. He developed a method of determining these complexes from a study of neutralization curves, and studied complexes formed by various metal ions of the transition series with polyamines below tetraethylenepentamine.

The formation constant for $[\text{Nitetren}]^{2+}$ has been measured at 25°, by the method of Bjerrum (1,3). This method, however, does not give information relative to the stability and presence of "hydrogen complexes," therefore the method of Schwarzenbach was extended to pentamines and utilized to determine what "hydrogen complexes" are present and to determine their stabilities.

The basicity constants for tetren were calculated from the neutralization curve obtained by titrating tetren pentahydrochloride with sodium hydroxide. Apparent basicity constants were calculated from the neutralization curve obtained by titrating a solution of tetren pentahydrochloride containing a ten fold excess of the Ni(II) ion. As a result of the comparison of the basicity constants and the apparent basicity constants by the method of Schwarzenbach, the following overall neutralization and complex formation process was indicated:



It was also shown that no polynuclear complexes are formed under the conditions studied.

The formation constants for the complexes $[\text{NiHtetren}]^{3+}$ and $[\text{Nitetren}]^{2+}$ were calculated at 15°, 25°, and 35°C. in order to obtain the thermodynamic quantities, ΔH , ΔF , and ΔS , from the variation of the constants with temperature. The formation constants (log K) obtained for the above complexes at 25°C. were 12.82 and 17.78 respectively.

Often the experimental uncertainties in the numerical values of the constants are of such magnitude, compared with the variation of the constants with temperature, that the thermodynamic data thus obtained are not reliable. For this reason calorimetric measurements of the heat of reaction between nickel(II) and tetren were made, as well as calorimetric measurements of the heat of neutralization of tetren pentahydrochloride. The value obtained for the

heat of neutralization of tetren pentahydrochloride was -20.60 Kcal./mole, and that obtained for the heat of reaction between the Ni(II) ion and tetren was -10.43 Kcal./mole. These values were found to agree well with the values obtained from the variation of the constants with temperature as measured by the method of Schwarzenbach.

Thermodynamic data have been calculated from the variation of the formation constants with temperature for complexes of iron(II) and manganese(II) with tetren (4). Measurements of the heat of reaction between these ions and tetren were also made calorimetrically in order to obtain further quantitative thermodynamic data for these reactions. The heat of reaction obtained in the case of iron(II) with tetren was -9.36 Kcal./mole which was found to agree well with that calculated from the formation constants measured by Schaafsma (4) by the method of Bjerrum (3). The value for the heat of reaction of Mn(II) with tetren obtained calorimetrically does not, however, agree closely with that obtained from the formation constants measured by Schaafsma. The calorimetrically determined heat of reaction was found to be -5.16 Kcal./mole while that obtained from the formation constants was -3.67 Kcal./mole. It is probable that the calorimetrically determined heat of reaction better represents the true value, since the variation with temperature of the formation constants of the Mn(II)-tetren complex approaches the limit of error of the potentiometric method of measurement. Potentiometric determination of formation constants can, at best, yield constants with a certainty of ± 0.02 log units, which will reflect an uncertainty of ± 1.00 Kcal./mole in the case of the Mn(II)-tetren complex.

The magnetic susceptibility of two solid complex compounds, [Nitetren(EtOH)] (ClO₄)₂ and [Nitetren(sec-BuOH)] (ClO₄)₂ were measured yielding 3.2 and 2.9 B.M. respectively, values which seem consistent with the utilization of 4s4p³4d² bond orbitals.

Two solid complex compounds of nickel(II) and tetren with n-propyl amine and n-butyl amine were prepared. The analysis of these compounds is consistent with the formulas [Nitetren(n-propyl amine)] (ClO₄)₂ and [Nitetren(n-butyl amine)] (ClO₄)₂.

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CHEMISTRY, ORGANIC

TRANSCARBONYLATION REACTIONS WITH POLYPHOSPHORIC ACID IN THE SYNTHESIS OF SYMMETRICAL DIARYL KETONES FROM DUROIC ACID

(L. C. Card No. Mic 59-2001)

Gerald Robert Bakker, Ph.D.
University of Illinois, 1959

When the cleavage of hindered ketones with polyphosphoric acid was extended to ketones having a phenyl radical in a position *ortho* with respect to the carbonyl group, the expected acids were not isolated, but underwent ring closure. This transformation has been applied to the formation of linear ketones by heating a mixture of duroic acid and an aromatic compound in polyphosphoric acid. Treatment in this manner of anisole, diphenyl ether, *m*-xylene and toluene produced the corresponding symmetrical diaryl ketones in yields up to 41 percent.

The first step of the overall change, presumed to be an acylation catalyzed by polyphosphoric acid, had not been realized previously with duroic acid. With shorter periods of heating it was possible to isolate the corresponding diaryl ketones in yields of 20 to 85 percent. The 2,4-dimethoxyphenyl, *p*-anisyl, *p*-phenoxyphenyl, 2,4-dimethylphenyl, *p*-tolyl and α -naphthyl diaryl ketones were thus prepared.

The aromatic acid, product of the next proposed step, could also be isolated in the series of reactions with *m*-xylene and toluene. 2,4-Dimethylbenzoic acid was obtained in a 12 percent yield when diaryl 2,4-dimethylphenyl ketone was heated with polyphosphoric acid.

The final presumed step, acylation of the aromatic compound by the corresponding acid was demonstrated in the preparation of di-*p*-tolyl ketone and 2,4,2',4'-tetramethylbenzophenone in yields of 47 and 66 percent, respectively.

Microfilm \$2.00; Xerox \$5.00. 96 pages.

A STUDY ON MALONALDEHYDE DERIVATIVES. THE FORMATION OF THE PYRIDO(2,3d)-PYRIMIDINE RING SYSTEM.

(L. C. Card No. Mic 59-2222)

Raffaele Bernetti, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Charles C. Price

After a critical discussion of the known synthetic routes leading to the pteridine moiety of pteroylglutamic acid, two possible new approaches are examined.

The first scheme is based on the condensation of an appropriate 4-amino-5-nitrosopyrimidine with malonaldehyde or its monoanils with *p*-aminobenzoic acid and alkyl *p*-aminobenzoate (R = methyl, ethyl). In this connection a number of unsuccessful experiments are described and an explanation for the negative results is given. In some cases, the lack of solubility of both starting materials in the required solvents and media and, in other cases, the lack of stability of at least one of the same starting

materials at the reaction conditions are considered as the main factors preventing the practical realization of the approach. The preparation of some mono- and dianils of malonaldehyde with *p*-aminobenzoic acid and alkyl *p*-aminobenzoate is described.

The second scheme takes advantage of a condensation product between nitromalonaldehyde and 2,4-diamino-6-hydroxypyrimidine described by Ulbricht and Price. The product, however, fails to react in the expected direction, thus leading to the suspicion that the monoanil structure proposed for this compound may not be correct. A number of possible structures are therefore examined. A choice is eventually made possible by the following sequence of reactions: reduction of the compound with stannous chloride and hydrochloric acid gives a diazotizable amine; treatment of the stable diazonium salt with hypophosphorous acid yields a compound possessing an identical ultraviolet spectrum to that reported by Robins and Hitchings for 2-amino-4-hydroxypyrido(2,3d)pyrimidine. Condensation of methyl 2-aminonicotinate with guanidine provides a new, direct route to the latter compound. Comparison (infrared absorption, X-ray diffraction data) with the authentic sample shows that the reduction product of the diazonium salt is indeed 2-amino-4-hydroxypyrido(2,3d)pyrimidine. It is concluded, therefore, that nitromalonaldehyde and 2,4-diamino-6-hydroxypyrimidine condense giving 2-amino-4-hydroxy-6-nitropyrido(2,3d)pyrimidine. The latter can be reduced with stannous chloride to 2,6-diamino-4-hydroxypyrido(2,3d)pyrimidine.

Condensation of 2,4-diamino-6-hydroxypyrimidine with malonaldehyde in mildly acidic conditions gives a highly crystalline product for which a dianil structure is proposed. This compound yields 2-amino-4-hydroxypyrido(2,3d)pyrimidine by treatment with concentrated sulfuric acid. The identity with the authentic sample is established by physical data as above.

A complete survey of previous work on pyrido(2,3d)-pyrimidines is given. Infrared, ultraviolet absorption spectra and X-ray diffraction spectra are tabulated in an appendix. Microfilm \$2.00; Xerox \$4.00. 74 pages.

POLYPYRIDINES FROM POLYVINYL KETONES

(L. C. Card No. Mic 59-2010)

Donald James Casey, Ph.D.
University of Illinois, 1959

The polymerization of methyl vinyl ketone and phenyl vinyl ketone was investigated, and procedures developed for the preparation of high molecular weight polymers from these vinyl ketones. Methyl vinyl ketone polymers having inherent viscosities in the range 0.63-1.45 were obtained using potassium persulfate in potassium caproate or potassium laurate solutions containing varying amounts of sodium chloride to decrease the water solubility of the monomer. With a previously reported aqueous solution procedure, polymers having a maximum inherent viscosity of 2.99 (molecular weight in the order of 10^5) were obtained at temperatures of 26° to -15°. Standard emulsion techniques were applied to phenyl vinyl ketone to prepare polymers with inherent viscosities ranging from 0.11 to 0.65. Lower molecular weight polymers of phenyl vinyl

ketone (inherent viscosities of 0.03 to 0.10) were prepared using anionic catalysts such as sodium or lithium in liquid ammonia, sodium ethoxide, sodium cyanide or potassium cyanide. No polymers were obtained with cationic catalysts such as stannic chloride and boron trifluoride etherate.

Polymethyl vinyl ketone was converted to polymethyl vinyl ketoxime, and the polyoxime, under the conditions of the Knoevenagel 1,5-dioxime ring closure reaction, gave a copolymer of methyl vinyl ketone and "2,6-dimethylpyridine" containing 76.2 mole percent of "pyridine" units. The presence of the substituted pyridine nucleus in the polymer was established by elemental analysis, neutralization equivalent, infrared, and ultraviolet analysis.

Polyphenyl vinyl ketone was converted to copolymers of phenyl vinyl ketone and phenyl vinyl ketoxime containing 27.5 to 81.3 mole percent ketoxime by the oximation of the polyketone under a variety of reaction conditions. A copolymer consisting of 70.2 mole percent phenyl vinyl ketoxime was converted to a copolymer of phenyl vinyl ketone and "2,6-diphenylpyridine" incorporating 50.3 mole percent of the "pyridine" moiety. The presence of the pyridine units in this copolymer was established by elemental analysis, infrared, and ultraviolet analysis.

The thermal stability of the "pyridine" containing polymers was briefly investigated. Neither polymer was found to be stable at 300°. At 225°, the "2,6-dimethylpyridine" copolymer lost 3.2% of its weight in twelve hours while the "2,6-diphenylpyridine" copolymer lost 2.7% of its weight in the same time.

Attempts to polymerize acrolein oxime, α -ethylacrolein oxime, methyl vinyl ketoxime, and acrolein oxime acetate by free radical, anionic, and cationic procedures were unsuccessful. Only impure monomer or small amounts of unidentifiable oils were recovered from these polymerizations.

The reaction of phenyl vinyl ketone with hydroxylamine was found to yield bis-(β -benzoyl ethyl)hydroxylamine or the dioxime of this compound. Similarly, phenyl vinyl ketone and methoxyamine produced bis-(β -benzoyl ethyl)-methoxyamine, and *p*-methoxyphenyl vinyl ketone with methoxyamine formed bis-[β -(*p*-methoxybenzoyl ethyl)-methoxyamine].

A mixture of compounds which were evidently dimers of phenyl vinyl ketone was produced in the reaction of benzonitrile and vinylmagnesium bromide. No conclusive structural assignments could be made for these products.

Microfilm \$2.00; Xerox \$5.40. 110 pages.

REACTIONS OF GRIGNARD REAGENTS OF SULFONES WITH ORTHOESTERS AND ALKYL HALIDES

(L. C. Card No. Mic 59-1871)

Raymond Donald Clark, Ph.D.
Vanderbilt University, 1959

Supervisor: Professor Lamar Field

The reaction of *p*-tolylsulfonylmethylmagnesium bromide (I) with ethyl orthoformate (II) was studied. When the reaction of I and II was carried out in the usual way, no product was isolated, but under forcing conditions, with

II as solvent, a compound was isolated, along with recovered methyl *p*-tolyl sulfone (III), which proved to be 1,3,5-tris-*p*-tolylsulfonylbenzene (IV). Ethyl bromide was also formed.

The structure of the trisulfone (IV) was confirmed by analysis, by infrared spectroscopy, by oxidation, and by independent synthesis.

The trisulfone (IV) was prepared independently simply by heating dimethyl *p*-tolylsulfonylacetate (V) at 110-120° for seventy-three hours. The acetal (V) was prepared from sodium *p*-toluenesulfinate and dimethyl chloroacetal by heating a mixture of the two compounds in dimethyl formamide. Other seemingly possible routes to the synthesis of IV (i.e., heating V with water, with hydrochloric acid, and with sodium ethoxide) were unsuccessful in producing appreciable amounts of IV.

The possibility that IV could be prepared from II and III simply by heating in the presence of a strong base or without a catalyst also was explored. No reaction occurred when II and III were heated together at 110-120° for nineteen hours. Neither could any of the trisulfone (IV) be isolated from the reaction of II and III with sodamide under the conditions used previously for the formation of IV. Catalysis by bromomagnesium ethoxide also did not effect reaction.

The reactions leading to IV are probably quite numerous and complex. It is not the purpose of this thesis to specify how IV is formed; nevertheless, a good deal can be said about the reaction. A number of reaction paths may be written for the formation of IV but certain ones are more appealing than others.

The most appealing of the reaction paths that were considered has as a first step the conversion of I to diethyl *p*-tolylsulfonylacetate (VI). The second step involves the replacement of an active hydrogen atom of the acetal (VI) with a bromomagnesium moiety to yield the corresponding Grignard reagent (VII). The third step is a loss of bromomagnesium ethoxide in a Boord type of reaction to yield 1-*p*-tolylsulfonyl-2-ethoxyethene (VIII). Phenylmagnesium bromide is known to add to α,β -unsaturated sulfones. By analogy, I can add to VIII as a fourth step. Logical further application of similar steps leads to the trisulfone (IV).

The ethyl bromide formed in the reaction apparently arises from the reaction of bromomagnesium ethoxide with II.

It seems that in order for IV to be produced from I and II, two protons must be lost from each molecule of I. These protons are certainly transferred (in some manner) to unreacted I (if alcohol were formed this also would exchange a proton with I) with subsequent regeneration of III. Thus, the stoichiometry of the reaction would be the same no matter what the reaction path, with nine moles of I yielding one mole of IV and six moles of III. Experimental results were consistent with this stoichiometry.

α -(*p*-Tolylsulfonyl)isopropylmagnesium bromide reacts normally with II to give the expected *p*-tolylsulfonyldimethylacetate which was isolated as such in 29% yield and in 60% yield as the corresponding 2,4-dinitrophenylhydrazones.

Ethyl orthoacetate reacts with I to give 1-*p*-tolylsulfonyl-2,2-diethoxypropane only in trace amount.

Benzhydriyl chloride reacts with phenylsulfonylmethylmagnesium bromide to give β,β -diphenylethyl phenyl sulfone in only 6% yield despite vigorous experimental conditions. *t*-Butyl chloride does not react with I.

In earlier work, the reaction of di-*p*-tolyl disulfide with I yielded an unidentified product. This product was proved to be tris-*p*-tolyl trithioorthoformate. It could arise from a series of reactions similar to that formulated for I \rightarrow IV.

This work and earlier work suggests that Grignard reagents of sulfones have little resemblance to carbanions (stabilized by an enolate canonical form) and are simply weakly nucleophilic Grignard reagents.

Microfilm \$2.00; Xerox \$5.60. 115 pages.

PART I: THE REACTION OF METHYL RADICALS WITH α -DEUTEROISOBUTYRYL CHLORIDE. PART II: THE REACTION OF METHYL RADICALS WITH α -DEUTERO-HEXAHYDROBENZOYL CHLORIDE.

PART III: THE REACTION OF PHENYL RADICALS WITH 2,4-DINITROTRITIOBENZENE.

(L. C. Card No. Mic 59-2226)

Robert James Convery, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Charles C. Price

Part I-

When chlorine atoms are reacted with isobutyryl chloride, a mixture of 80% β -chloro- and 20% α -chloroisobutyryl chloride is obtained. However, when methyl radicals are reacted with isobutyryl chloride, a 62% yield of product (tetramethylsuccinic anhydride) derived from reaction at the α position of the acyl chloride is obtained. Two different mechanisms have been proposed for the anomalous reaction of the methyl radicals. They are; a) preferential attack of the methyl radicals at the α position of the acyl chloride and b) statistical attack of the methyl radicals at the α and β positions of the acyl chloride followed by a further reaction of the β radicals to form additional α radicals.

In an attempt to select the correct mechanism for this reaction, diacetyl peroxide was decomposed in α -deuteroisobutyryl chloride. Different concentrations of deuterium in the acyl chloride were used in separate experiments and the methane which was formed was analyzed for deuteromethane by mass spectrometry. The experimental data were used to solve kinetic equations. A value of 5.2 ± 0.5 was obtained for the isotope effect ($k_{\alpha}^H/k_{\alpha}^D$) and a value of 26.7 ± 5.2 was obtained for the ratio of the rate of attack at the α position to the rate of attack at the β position (k_{α}/k_{β}).

The experimental value of k_{α}/k_{β} indicates that $82 \pm 3\%$ of the attack of the methyl radicals on the isobutyryl chloride is at the α position. Therefore, methyl radicals have a greater selectivity than chlorine atoms for the α of the acyl chloride and mechanism a is preferred for this reaction.

Part II-

From the reaction of chlorine atoms with hexahydrobenzoyl chloride, 34% of the α chlorinated product is obtained. In this reaction, contrary to the reaction of chlorine atoms with isobutyryl chloride, the chlorine atom exhibits a selectivity for the α position of the acyl chloride.

The reaction of methyl radicals with hexahydrobenzoyl

chloride was investigated to determine the difference, if any, in selectivity between the chlorine atom and the methyl radical for the α position of this acyl chloride.

The experimental procedures were the same as those used in Part I. The data obtained from the decomposition of diacetyl peroxide in α -deuterohexahydrobenzoyl chloride did not yield any firm solution of the kinetic equations for this reaction. Some possible causes of the difficulties encountered in solving the kinetic equations are discussed.

Part III-

When phenyl radicals are produced in aromatic solvents, biaryls are formed which are derived from the phenyl radical and the solvent. Two mechanisms have been proposed for this reaction. They are; a) the abstraction of a hydrogen atom from the aromatic compound with subsequent coupling of the resultant aryl radical with a second phenyl radical and b) the addition of a phenyl radical to a double bond of the aryl molecule with subsequent loss of a hydrogen atom from the intermediate radical.

The decomposition of benzoyl peroxide in 2,4-dinitrotritiobenzene was studied in an attempt to elucidate the mechanism of this reaction. In mechanism a, the rate determining step, that is, hydrogen abstraction, would be expected to exhibit an isotope effect. In mechanism b, the rate determining step, the addition of a phenyl radical to a double bond, should not exhibit an isotope effect. The reactions were carried to at least 80% completion and tritium assays were made with the initial 2,4-dinitrotritiobenzene and with that which was recovered from the reaction mixture. In duplicate experiments, no isotope effects were found. Therefore, mechanism b is preferred for the reaction of phenyl radicals with aromatic compounds.

Microfilm \$2.00; Xerox \$3.60. 62 pages.

THE SYNTHESIS AND CHEMISTRY OF 6,6-DIMETHYL-6,11-DIHYDROBENZ(b)- ACRIDINE AND DERIVATIVES

(L. C. Card No. Mic 59-1782)

John Cyrenius David, Ph.D.
The University of Nebraska, 1958

Adviser: Norman H. Cromwell

The benz(b)acridines have received less attention than the benz(a)- or benz(c)acridines. The purpose of this investigation was to synthesize 6,6-dimethyl-6,11-dihydrobenz(b)acridine (III) and derivatives and to elucidate the chemical characteristics of this system. The dihydrobenzacridine (III) is believed to be the first reported compound containing gem-disubstituted meso positions adjacent to a heterocyclic ring.

The dihydrobenzacridine (III) was synthesized by two routes and its structure further verified by the similarity of its ultraviolet spectrum to that of quinoline. The amino acid, 6,6-dimethyl-12-carboxy-6,11-dihydrobenz(b)acridine (IV) and 1,1-dimethyl-3-(o-nitrobenzal)-2-tetralone (II) were prepared as intermediates in the synthesis of the dihydrobenzacridine (III).

The bromide, 6,6-dimethyl-11-bromo-6,11-dihydrobenz(b)acridine (VI) could not be isolated, but the crude

product of the reaction of III with N-bromosuccinimide reacted rapidly with morpholine, methanol and ethanol to give the 11-morpholino (VII), 11-methoxy (VIII), and 11-ethoxy (IX) derivatives of the dihydrobenzacridine (III), respectively and with water and air to give 6,6-dimethyl-11-keto-6,11-dihydrobenz(b)acridine (V). Ultraviolet and infrared spectra were of help in identifying the structures of these derivatives.

The ketobenzacridine (V) was also formed by the direct oxidation of the dihydrobenzacridine (III) and was found to form an oxime (XIII) with difficulty. This ketone (V) was found to undergo 1,2 addition with methyl magnesium iodide to form 6,6,11-trimethyl-11-hydroxy-6,11-dihydrobenz(b)acridine (XI) and conjugate addition with phenyl magnesium bromide to form 6,6-dimethyl-11-keto-12-carboxy-6,11-dihydrobenz(b)acridan (XII), which was oxidized to the 12-phenyl derivative of (V), 6,6-dimethyl-11-keto-12-phenyl-6,11-dihydrobenz(b)acridine (XIV).

Catalytic hydrogenation of the ketobenzacridine (V) resulted in the formation of 6,6-dimethyl-11-keto-6,11-dihydrobenz(b)acridan (XV), for which the structural similarity to the 12-phenyl ketoacridan (XII) was recognized by similarity of their ultraviolet spectra.

A study of the ultraviolet spectra of the ketobenzacridans (XV) and (XII) and of the open-chain model, 1-phenyl-3-anilino-2,3-butene-1-one (XX) in neutral, basic and acid solution was made. An explanation of the bathochromic shift of the ultraviolet absorption maximum of the ketobenzacridan (XV) on formation of its acid salt is offered and applied to related phenomena in other cyclic β -amino- α,β -unsaturated ketones.

A study of the infrared spectra of the β -amino- α,β -unsaturated ketones (XV), (XII) and (XX) in the solid state and in solution was made. Absorption bands resulting from the N-H and C=O stretching vibrations of free and intermolecularly bonded molecules of the cyclic structures (XV) and (XII) were recognized.

The dibromide of (II), 1,1-dimethyl-3-bromo-3-(α -bromobenzal)-2-tetralone (XVII) was prepared by bromination of (II) and thermally decomposed to a monobromide (XVIII) to which the structure, 1,1-dimethyl-2-keto-3-(α -bromobenzyl)-1,2-dihydronaphthalene was tentatively assigned on the basis of comparison of its spectra with those of related compounds.

Microfilm \$2.00; Xerox \$6.40. 132 pages.

THE PREPARATION AND DECOMPOSITION STUDIES OF BENZYL AZOALKANES

(L. C. Card No. Mic 59-1770)

Adolph Vincent DiGiulio, Ph.D.
Polytechnic Institute of Brooklyn, 1959

Adviser: Charles G. Overberger

In previous work, Overberger and co-workers had prepared a number of aliphatic azo nitriles of the general structure $(R)(CH_3)(CN)C=N=N-C(CN)(CH_3)(R)$ and investigated the effect of varying the R groups on the rate of thermal decomposition to nitrogen gas and two free radicals. The methyl groups of the above structure were also eventually replaced by other alkyl groups to determine the

effect of structure on reactivity. The enhanced reactivity of the azo nitriles wherein branching occurred at the carbon beta to the azo carbon had been attributed chiefly to F - strain in the concept of H. C. Brown. However, recent work by Hyson, Beasley, et al., on the carbamyl azo nitriles showed the need for a modification of this concept, and it now appears that some form of B strain is the chief steric factor enhancing the reactivity of the azo nitriles.

The purpose of the present work was to extend the study of the effects of structure on the homolytic dissociation of unsymmetrical aliphatic azo compounds particularly where the two radicals attached to the azo linkage were of considerable difference in stability. In addition, it was thought that a study of this type of azo compound would shed some light on the problem as to whether the thermal decomposition of aliphatic azo compounds occurred with the simultaneous rupture of both carbon-nitrogen bonds in the rate determining step as proposed by Ramsperger or occurred in a stepwise manner. Toward these ends, the unsymmetrical benzylazoalkanes of the general structure $(\emptyset)(R)(R')-C=N-N-C(R'')(R)(H)$ were prepared and their rates of decomposition studied.

Finally, since azo compounds afford a clean cut method for obtaining free radicals, and since the products formed from these free radicals can give information concerning the relative stabilities and behavior of the radicals themselves, it was of interest to study the products of decomposition of the unsymmetrical azo compound where $R=CH_3$, $R'=R''=i-C_4H_9$.

Part I. - The reaction of phenylmagnesium bromide or phenyllithium on acetaldehyde azine, acetone azine, diethyl ketazine and methylisobutyl ketazine gave the corresponding mono 1,2,- addition product, α -phenylethyl-, α -cumyl-, α,α -diethylbenzyl- and, α -methylisobutyl-benzyl-hydrazone respectively of the parent carbonyl. Distillation of the reaction mixture obtained with cyclohexanone azine gave apparently hydrocarbon decomposition products. The pure free bases α -phenylethylhydrazine and α -cumylhydrazine were obtained by hydrolysis of the respective hydrazones. Condensation of α -phenylethylhydrazine with acetone gave acetone α -phenylethylhydrazone. The four azo compounds, α -phenylethylazoisopropane (I), α -cumylazoisopropane (II), α,α -diethylbenzylazo-3-pentane (III), and α,α -methylisobutylbenzylazo-2-(4-methylpentane) (IV) were obtained by the oxidation of their respective hydrazines which in turn were obtained by the hydrogenation of the corresponding hydrazones.

Part II. - The decomposition of IV in xylene led to a mixture of products resulting from combination and disproportionation reactions of the α,α -methylisobutylbenzyl radical and the methylisobutylcarbonyl radical as well as to product derived from solvent interaction with these radicals.

Part III. - The four unsymmetrical benzylazoalkanes, I, II, III, and IV were decomposed in diphenyl ether with first order kinetics, the E_A and ΔS^\ddagger being determined in each case. Similar rates were obtained in the presence of benzoquinone. Comparisons between I, II, III, and IV were made, as well as with azo-bis-isopropane and 1-azo-bis-1-phenylalkanes and the differences in reactivity were discussed in terms of hyperconjugation and "B" strain.

Additional evidence was obtained to support Ramsperger's suggestion that in the thermal decomposition of aliphatic azo compounds probably both radicals attached to the azo linkage assist in the elimination of nitrogen in the rate determining step. Microfilm \$2.25; Xerox \$7.80. 169 pages.

THE AUTOXIDATION OF ENOL FORMS OF HINDERED 1,2-DIAROYL CYCLOALKANES. A NEW ROUTE TO EPOXY KETONES.

(L. C. Card No. Mic 59-2019)

James Love Fedrick, Ph.D.
University of Illinois, 1959

A new reaction, epoxidation of hindered 1,2-diaroylcycloalkanes with molecular oxygen, has been discovered. Treatment of trans-1,2-dimesitylcyclohexane, trans-1,2-diduroylcyclohexane, and 1,2-dimesitylcyclopentane with a Grignard reagent followed by air oxidation in a strongly acidic solution yielded cis-1,2-dimesityl-1-cyclohexene oxide (89%), cis-1,2-diduroyl-1-cyclohexene oxide (74%), and cis-1,2-dimesityl-1-cyclopentene oxide,² respectively.

A mechanism which is in agreement with experimental evidence is proposed. It is believed that the reaction of the initial diketone with a Grignard reagent followed by hydrolysis of the resultant dienol salt yields a stable mono-enol. Molecular oxygen converts this mono-enol to an intermediate "Kohler" peroxide; the "free" ketone function of the resultant peroxide then enolizes in the strongly acidic solution. Protonation of this hydroperoxide generates a cationic oxygen ion in the transition state which subsequently attacks the adjacent enol double bond to yield the product, a symmetrical epoxide.

Autoxidation of the enol of trans-1,2-dimesitylcyclohexane in dilute acidic solution gave a mixture of cis-1,2-dimesitylcyclohexane, cis-1,2-dimesityl-1-cyclohexene oxide, 2-mesityl-1-cyclohexen-1-ol, and mesitoic acid. It is believed that mesitoic acid and 2-mesityl-1-cyclohexen-1-ol were formed by an internal four-centered reaction.

Platinum catalyzed oxidation of the mono-enol of trans-1,2-dimesitylcyclohexane yielded 1,6-dimesityl-1-cyclohexene. This same compound was made by iodine oxidation of the dienol salt of trans-1,2-dimesitylcyclohexane. Treatment of the olefin with basic hydrogen peroxide solution yielded 1,6-dimesityl-1-cyclohexene oxide.

The structure of the symmetrical epoxide, cis-1,2-dimesityl-1-cyclohexene oxide, was established in the following way. The compound was known to have an ether bridge on the cyclohexane ring.³ That this oxygen atom was bridged across the carbon atoms adjacent to the ketone groups was demonstrated by a 22 m μ difference of the carbonyl peaks in the ultraviolet spectra of starting material and product. This same shift was observed in the comparison of the ultraviolet spectra of 1,2-dimesityl-ethane and 1,2-dimesitylethylene oxide. Bands for tertiary hydrogen atoms α,α' to the carbonyl groups present in the nuclear magnetic resonance and infrared spectra of the starting material were absent in those of the product; furthermore, the infrared spectrum of the product had a split carbonyl band and bands characteristic of a symmetrical epoxide. The structure of cis-1,2-diduroyl-1-cyclohexene

oxide and the structure of *cis*-1,2-dimesitylcyclopentene oxide were established in a similar fashion.

An improved procedure was developed for the synthesis of hindered *trans*-1,2-diaroylcyclohexanes starting with commercially available *cis*-hexahydrophthalic anhydride. The isomer of 1,2-diduroylcyclohexane previously reported as a *trans*-isomer was shown to be the *cis*-isomer.

Microfilm \$2.00; Xerox \$5.20. 103 pages.

I. POLYMERIZATION OF HIGHER α -DIOLEFINS WITH METAL ALKYL COORDINATION CATALYSTS.

II. POLYMERS FROM THE ELECTROLYSIS OF DIBASIC ACIDS.

(L. C. Card No. Mic 59-2021)

William Emmett Garrison, Jr., Ph.D.
University of Illinois, 1959

I.

The synthesis and the polymerization by metal-alkyl coordination catalysts, of 1,7-octadiene, 1,8-nonadiene, 1,9-decadiene, 1,10-undecadiene, 1,11-dodecadiene, 1,12-tridecadiene, 1,13-tetradecadiene, 1,14-pentadecadiene, 1,15-hexadecadiene, 1,17-octadecadiene, and 1,21-docosadiene have been described. The preparation of these α -diolefins was accomplished by four general procedures. The coupling of the appropriate ω -unsaturated magnesium halide of the α,ω -dimagnesium halide with allyl bromide, the Wurtz reaction of an ω -unsaturated halide, the Boord olefin synthesis, and the pyrolysis of the appropriate ω -acetoxyolefin or the α,ω -diacetoxy compound.

The higher α -diolefins, 1,24-tetracosadiene, and 1,25-hexacosadiene have been obtained as by-products from the Grignard syntheses of 1,14-pentadecadiene and 1,15-hexadecadiene. These higher α -diolefins have not been previously reported, and represent the longest known members of the series.

When treated with metal alkyl coordination catalysts, these α -diolefins yielded both soluble and insoluble polymers. The soluble polymers are generally low-molecular weight semi-solid materials, possessing cyclic units, hanging terminal olefinic groups, and internal, chiefly *trans*, unsaturation resulting from the rearrangement of the terminal olefin during the polymerization process. In order to substantiate the concept of a rearrangement, the methanol-soluble fraction from the polymerization of 1-octadecene was examined, and it was found that during the polymerization twenty per cent of the monomer had undergone rearrangement to another octadecene possessing an internal olefinic bond.

The insoluble polymers apparently contain a low degree of cross-linking as evidenced by the ease with which they form a thin gel when treated with benzene. Except for the occasional cross-linkages, the structure of the insoluble polymers is similar to that of the soluble fraction, as indicated by their infrared spectra. Quantitative measurements of unsaturation in the soluble polymer by means of infrared spectrometry and bromination indicate that there is some phenomenon, other than cross-linking, which uses up more than one of the olefinic groups in the monomer.

This can be explained if an intramolecular-intermolecular cyclization process is considered. The quantitative determinations show that the unsaturation in the polymer decreases with increasing dilution of the monomer in the polymerization recipe. The relationship between the unsaturation in the polymer and the chain length of the monomer is not so clearly defined. The least amount of terminal unsaturation has been obtained in poly-1,7-octadiene, while poly-1,10-decadiene possesses the greatest degree of terminal unsaturation.

II.

The heretofore unknown monomethyl ester of dotriacontane-1,21-dicarboxylic acid has been prepared. The electrolysis of monomethyl sebacate produced dimethyl hexadecane-1,16-dicarboxylate, and this was converted to the half ester by hydrolysis with barium hydroxide in methanol. Electrolysis of monomethyl hexadecane-1,16-dicarboxylate in ethanol yielded dimethyl dotriacontane-1,32-dicarboxylate. The hydrolysis of this material with barium hydroxide in tetrahydrofuran-methanol produced monomethyl dotriacontane-1,32-dicarboxylate. This material could not be electrolyzed, and so an attempt to prepare dimethyl tetrahexacontane-1,64-dicarboxylate failed.

The electrolysis of a series of dicarboxylic acids as their ammonium salts in methanol has also been described. No polymer was obtained from malonic, succinic, glutaric, or β,β -dimethyl glutaric acid. The electrolyses of adipic, azelaic, sebacic, and hexadecane-1,16-dicarboxylic acids produced polymers which were separated into insoluble and benzene-soluble fractions. The soluble fractions are low molecular weight linear polymers, containing some ester linkages. The electrolysis of *m*-phenylene diacetic acid produced a rather thermostable cross-linked polymer, and no soluble fraction was obtained.

Microfilm \$2.00; Xerox \$6.60. 138 pages.

CHEMISTRY OF STREPTOLYDIGIN

(L. C. Card No. Mic 59-2023)

Jerome Allen Gourse, Ph.D.
University of Illinois, 1959

The chemistry of the antibiotic streptolydigin of molecular formula $C_{32}H_{46}N_2O_9$ has been investigated for the purpose of elucidating its structure and general chemical nature. The molecule has been characterized by chemical methods and by infrared, ultraviolet, and nuclear magnetic resonance studies. Streptolydigin gave positive ferric chloride and titanium trichloride tests indicating the presence of a β -diketone grouping in the molecule. It also gave positive bromine and potassium permanganate tests indicating the presence of carbon-carbon double bonds. The position of the ultraviolet maximum suggests four carbon-carbon double bonds conjugated with the diketone system. Streptolydigin has also been shown to contain at least four hydroxyl groups, at least four C-methyl groups, and at least one amide group.

The effect of different catalysts and solvents on the hydrogenation of streptolydigin has been studied to determine the nature and extent of the unsaturated system. The

hydrogenated products, hexahydrostreptolydigin, decahydrostreptolydigin, and tetradecahydrostreptolydigin have been characterized by chemical methods and by infrared, ultraviolet, and nuclear magnetic resonance studies. Tetradecahydrostreptolydigin gave negative tests with ferric chloride and titanium trichloride indicating the absence of the diketone system.

Attempts have been made to obtain fragments of streptolydigin by cleavage of the molecule. Procedures have been investigated for the hydrolysis of streptolydigin and its hydrogenated derivatives with alkali. Methylamine was shown to be a product of basic hydrolysis of tetradecahydrostreptolydigin. This was the only identifiable product. Methylamine could not be obtained from the basic hydrolysis of streptolydigin.

Both periodate-permanganate oxidation and ozonolysis of streptolydigin have been studied. Acetaldehyde and two larger fragments, products of ozonolysis, have been isolated as their 2,4-dinitrophenylhydrazones. Acetone, apparently a product of acid hydrolysis, has also been isolated from the ozonolysis reaction. The isolation of acetone suggests the presence of an isopropylidene ketal in the molecule. One of the larger fragments isolated from the ozonolysis of streptolydigin has been shown to be an aldehyde and the other fragment has been shown to be a ketone.

A study of suitable model compounds has established the applicability of nuclear magnetic resonance spectroscopy in distinguishing between aldehyde and ketone 2,4-dinitrophenylhydrazones and semicarbazones.

Microfilm \$2.10; Xerox \$7.40. 160 pages.

**A STUDY OF THE ELECTRICAL EFFECTS
IN THE FERROCENE MOLECULE.
CHEMICAL STUDIES INVOLVING FERROCENE.
CONCERNING THE REDUCTION OF
HYDROCARBONS CONTAINING ACIDIC HYDROGEN.**

(L. C. Card No. Mic 59-1620)

Lewis Wendell Hall, Jr., Ph.D.
Purdue University, 1959

Major Professor: Dr. Robert A. Benkeser

A Study of the Electrical Effects in the Ferrocene Molecule. A series of heteroannular substituted ferrocene carboxylic acids ($\text{RC}_5\text{H}_4\text{FeC}_5\text{H}_4\text{CO}_2\text{H}$) where $\text{R} = \text{C}_6\text{H}_5\text{CH}_2$, $n\text{-C}_3\text{H}_7$, C_2H_5 , H , CH_3CO , $\text{C}_2\text{H}_5\text{CO}$, $\text{C}_6\text{H}_5\text{CO}$, CO_2H , $\text{C}_2\text{H}_5\text{-O}_2\text{C}$ have been prepared and their pK_a values determined. An attempt has been made to correlate the change in structure with σ_m , σ_p , and σ^+ . The present data correlates best with σ^+ . This is taken as an indication that interannular resonance is not operative in the ferrocene molecule.

Chemical Studies Involving Ferrocene. All attempts to prepare chloromethylferrocene, the analogue of benzyl chloride, failed. Presumably, the chloromethylferrocene is formed but is very reactive and undergoes polymerization by self alkylation under the conditions necessary to bring about the initial reaction.

The reaction of hydroxymethylferrocene with *p*-toluenesulfonyl chloride in ethyl ether gives bis diferrocenylmethyl ether as the only product of the reaction. This

suggests that the ferrocenylmethyl carbonium ion is a very stable ion.

Although nucleophilic displacements take place readily in the case of trimethylferrocenylmethyl ammonium iodide, the sodium salt of hydroxymethyl ferrocene fails to displace iodide ion from ethyl iodide.

Carbomethoxyferrocene fails to react with zinc chloride in the presence of aluminum chloride.

Ferrocene enters into a reaction with trichloroacetone in the presence of aluminum chloride to give trichloroacetylferrocene, but the yields are poor.

Phenylferrocene and ethylferrocene fail to undergo metallation with *n*-butyllithium in ethyl ether or refluxing hexane.

Concerning the Reduction of Hydrocarbons Containing Acidic Hydrogen. The reduction of 9,9-dimethylfluorene with lithium in methylamine leads to a more highly saturated material than does the reduction of fluorene. This is probably due to the inability of the 9,9-dimethylfluorene which lacks acidic hydrogens, to develop a negative charge in the molecule. In contrast, fluorene, which has acidic hydrogens develops a negative charge which hinders reduction.

Dicyclopentadiene is reduced to 9,10-dihydrodicyclopentadiene. This is thought to be a result of strain in the bicyclic ring. Microfilm \$2.00; Xerox \$5.40. 109 pages.

**THE SYNTHESIS OF CERTAIN DIKETONES
AND THEIR CONVERSION INTO BISHYDANTOINS**

(L. C. Card No. Mic 59-2506)

Helmuth Erwin Hinderer, Ph.D.
The University of Texas, 1958

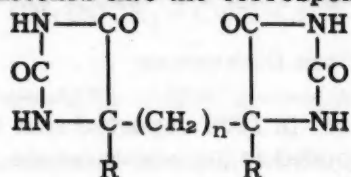
Supervisor: Henry R. Henze

The first phase of the investigation consisted in the preparation of diketones, of the type $\text{RCO}(\text{CH}_2)_n\text{COR}$, by the interaction of dialkylcadmiams and diacid chlorides. The dialkylcadmium compounds used contained the following alkyl groups: methyl through *n*-amyl, isobutyl and isoamyl. The diacid chlorides employed were: pimelyl chloride to produce seven 1,7-diketones, suberyl chloride to synthesize seven 1,8-diketones, and azeloyl chloride to prepare seven 1,9-diketones.

The "general procedure" giving satisfactory yields in the majority of preparations is briefly noted. Initially, the Grignard reagent was obtained by the interaction of magnesium and an ether solution of the appropriate alkyl bromide, and the dialkylcadmium compound was then formed by the portionwise addition of anhydrous cadmium chloride. Ether (removed by distillation) was replaced by anhydrous benzene and a solution of the diacid chloride in benzene added to the hot dialkylcadmium-salts slurry. The crude product, obtained after acid hydrolysis, was purified either by recrystallization (Skelly Solve "B" or "C") or fractional distillation in vacuo. The major deviation from the above procedure was in the preparation of 2,9-decanedione, for which "inverse addition" of the dimethylcadmium slurry to a solution of suberyl chloride was employed.

Each diketone was characterized by determining the appropriate physical "constants" and obtaining satisfactory carbon and hydrogen analyses. Disemicarbazones were prepared as derivatives for which nitrogen analyses were made. Of the twenty-one diketones prepared, sixteen represent initially synthesized compounds.

The second phase of the investigation involved the conversion of the diketones into the corresponding bishydantoin)s of the type



mixture of the diketone, potassium cyanide and ammonium carbonate in diluted ethyl alcohol. The crude product was obtained after acidification, concentration of the reaction mixture followed by dilution with water and chilling. In this manner the 1,7-diketones were converted into seven new 5,5'-pentamethylenebis(5-alkylhydantoin)s, the 1,8-diketones into seven new 5,5'-hexamethylenebis(5-alkylhydantoin)s, and six of the 1,9-diketones into new 5,5'-heptamethylenebis(5-alkylhydantoin)s.

The majority of the bishydantoin)s were obtained (generally in good yields) as materials possessing unsharp melting points due to the presence of a mixture of stereoisomers. Each of the twenty bishydantoin)s was subjected to fractional recrystallization in an attempt to isolate sharp-melting material. Melting points were determined for all fractions, and quantitative nitrogen determinations on numerous fractions (especially early in the recrystallization scheme and of sharp-melting fractions obtained later) served to establish that, although differing in melting points, the various fractions possessed similar and expected composition. Commonly, diluted ethyl alcohol (50% or 70%) was employed as the recrystallizing solvent, however, use was also made of ethyl acetate, benzene, carbon tetrachloride and acetone (usually in conjunction with methanol and ethanol).

Fractional recrystallization of each of the twenty bishydantoin)s prepared resulted in the isolation of a small quantity of higher-, sharp-melting material (consisting essentially of the "least soluble" material) representing one form of the bishydantoin). For six bishydantoin)s, a small quantity of another higher-, sharp-melting material (a second form) was also obtained via recrystallization of "more soluble" fractions. In the majority of cases the higher-, sharp-melting materials were obtained only after repeated recrystallization of single fractions or mixtures of fractions. In four instances, the bishydantoin)s were considered to consist predominantly of one form, because the majority of fractions (representing the bulk of the material) exhibited similar and sharp melting points.

Microfilm \$2.70; Xerox \$9.40. 208 pages.

THE PREPARATION OF PHOSPHORYLATED PYRIMIDINES

(L. C. Card No. Mic 59-1982)

James John Hodan, Ph.D.
The University of Buffalo, 1959

The reaction of 4-amino-5-formyl-2-methylthiopyrimidine with dialkyl and diaryl hydrogen phosphites has been described. Four substituted 5-pyrimidylhydroxymethylphosphonate esters were characterized.

Diethyl 5-(4-amino-2-methylthiopyrimidyl)hydroxymethylphosphonate was oxidized. The oxidized product was treated with ammonia. From these reactions diethyl 5-(2,4-diaminopyrimidyl)hydroxymethylphosphonate was prepared.

Hydrolysis of diethyl 5-(4-amino-2-methylthiopyrimidyl)hydroxymethylphosphonate gave two products. Depending upon reaction conditions diethyl 5-(4-amino-2-hydroxypyrimidyl)hydroxymethylphosphonate hydrochloride and 5-(4-amino-2-hydroxypyrimidyl)hydroxymethylphosphonic acid were prepared.

The Michaelis-Arbuzov reaction has been extended to pyrimidines. Trialkyl and triaryl phosphites were reacted with 4-amino-5-bromomethyl-2-methylthiopyrimidine hydrobromide. Five compounds of the type, dialkyl (diaryl) 5-(4-amino-2-methylthiopyrimidyl)methylphosphonate were characterized.

The reaction of 4-amino-5-hydroxymethyl-2-methylthiopyrimidine with phosphorus oxychloride gave 5-(4-amino-2-methylthiopyrimidyl)methyl phosphorodichloridate. This was reacted with ammonia, methylamine and ethyleneimine to give the corresponding phosphorodiamidates.

The reaction of thiophosphoryl chloride with 4-amino-5-hydroxymethyl-2-methylthiopyrimidine gave 5-(4-amino-2-methylthiopyrimidyl)methyl phosphorodichlorothioate. This upon treatment with ethyleneimine gave the corresponding phosphorodiamidate.

The reaction of 4-amino-5-hydroxymethyl-2-methylthiopyrimidine with dialkyl chlorophosphates and chlorothiophosphates gave tertiary phosphate and thiophosphate esters respectively.

The synthesis of phosphorus pyrimidines from tetraethyl phosphonomalonate was investigated, however, only negative results were obtained. A Claisen condensation between triethyl phosphonoacetate and ethyl acetate also failed.

Microfilm \$2.00; Xerox \$3.60. 64 pages.

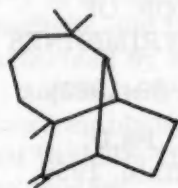
APPROACHES TO THE SYNTHESIS OF LONGIFOLENE

(L. C. Card No. Mic 59-2467)

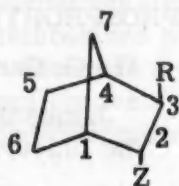
Norman John Hudak, Ph.D.
Cornell University, 1959

The sesquiterpene longifolene has been assigned structure I largely on the basis of X-ray diffraction studies. It was desired to develop synthetic routes to this unusual ring system.

Two main synthetic routes were pursued. One involved ionic additions to norbornene in which the products were 2,7-disubstituted norbornanes. Such derivatives seemed



I



II

desirable because they provide functional groups at positions destined for attachment of the seven-membered ring.

Treatment of norbornene with peracetic acid gave *exo*-2-acetoxy-*syn*-7-hydroxybicyclo[2.2.1]heptane. A carbonyl group at C₇ seemed to offer a convenient functional group for subsequent cyclization. However, all attempts to oxidize the hydroxy-acetate to a keto-acetate failed. An alternate route to a 7-ketonorbornane derivative via norbornene nitrosochloride was explored. Addition of nitrosyl chloride to norbornene should produce *exo*-2-chloro-*syn*-7-nitrosobicyclo[2.2.1]heptane. This compound would be expected to be in equilibrium with the corresponding oxime, which should hydrolyze to give the 2-chloro-7-ketone. Preliminary evidence indicated that a ketone was generated by this process, but the route was abandoned because the author developed an allergy to one of the compounds in the series.

The use of *syn*-7-chloronorcamphor as an intermediate was also investigated. The compound could be methylated at position 3, but the chlorine proved extremely resistant to displacement by iodine. Because of this lack of reactivity, it appeared improbable that a seven-membered ring could be readily produced by displacement of the chlorine in a subsequent ring closure step.

The second general route to longifolene involved as the key step the condensation of a suitably substituted dienophile with cyclopentadiene. After hydrogenation, a compound of type II would be expected. It was anticipated that generation of a carbonium ion at C₂ would result in a rearrangement producing a substance with the R group in the *syn*-7 position and another substituent on the 2 position. Thence, cyclization could be envisioned.

Using 4-cyano-2,2-dimethylbutyraldehyde as the starting material, the following potential dienophiles were synthesized: 5-cyano-3,3-dimethyl-1-nitro-1-pentene, 6-methoxy-3,3-dimethyl-1-nitro-1-hexene, ethyl 7-methoxy-4,4-dimethyl-2-heptenoate, and 7-methoxy-4,4-dimethyl-2-heptenoic acid. No adduct could be isolated from the attempted condensation of each of these compounds with cyclopentadiene. This lack of reactivity is probably due to steric hindrance in the neighborhood of the "dienophile's" double bond.

Another possible synthetic route is proposed.

Microfilm \$2.00; Xerox \$4.00. 72 pages.

THE HOMOGENEOUS, CUPRIC CHLORIDE CATALYZED, DECOMPOSITION OF 2,4-DICHLOROBENZENEDIAZONIUM CHLORIDE IN AQUEOUS ACETONE

(L. C. Card No. Mic 59-964)

Arthur King Ingberman, Ph.D.
New York University, 1956

Adviser: S. Carlton Dickerman

Meerwein et al¹ in 1939 reported that aryl diazonium chlorides decomposed in aqueous acetone when catalyzed by cupric chloride, to yield chloroacetone. The amount of chloroacetone formed varied with the specific diazonium chloride, the maximum of 65% of theory was obtained with 2,4-dichlorobenzenediazonium chloride. Previously, Waters² reported the heterogeneous decomposition of a suspension of benzenediazonium chloride in acetone at its boiling point, in the presence of suspended calcium carbonate, to result again in about 65% of the theoretical yield of chloroacetone, with evolution of nitrogen.

The object of this work was two fold: (a) Determine the course of the reaction of 2,4-dichlorobenzenediazonium chloride, and the nature of the products under the conditions claimed by Meerwein, since he did not isolate any reaction products. (b) Investigate some aspects of the mechanism whereby this reaction occurs.

The preparation of very pure, dry, 2,4-dichlorobenzenediazonium chloride was accomplished by a novel method which may have general utility. A suspension of 2,4-dichloroaniline hydrochloride in ether was treated with the stoichiometric amount of isoamyl nitrite. A heterogeneous reaction occurred, which was substantially complete within one hour at room temperature, and the insoluble substantially pure 2,4-dichlorobenzenediazonium chloride filtered off.

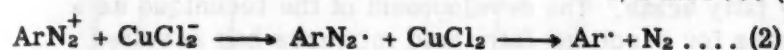
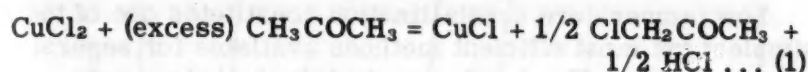
First the heterogeneous reaction of pure 2,4-dichlorobenzenediazonium chloride in acetone was carried out at 35°C. A rapid reaction occurred, with almost no evolution of nitrogen, which was complete within one hour. A buff colored, micro-crystalline compound m.p. 165°C of undetermined structure was isolated. When 2,4-dichlorobenzenediazonium chloride was permitted to decompose in homogeneous acetone-water solution, an equally rapid reaction was again observed, with very little evolution of nitrogen, but with the formation of a red crystalline product melting at 179-180°C, which is thought to be N,N'-di-(2,4-dichlorophenyl)-C-acetyl-formazan.

In the absence of acetone, aqueous solutions of 2,4-dichlorobenzenediazonium chloride were still incompletely decomposed after one year at room temperature. The presence of acetone caused the fairly rapid decompositions described above. However, no decomposition involving substantial evolution of nitrogen was observed until the addition of cupric chloride. Under these conditions a regular evolution of nitrogen resulted.

The rate of evolution of nitrogen increased with increasing cupric chloride concentration, increasing acetone-water ratios, and increasing temperature. The rate seemed to be unaffected by small amounts of sodium chloride, and diminished at lower temperatures. The products isolated in good yield from the cupric chloride catalyzed decomposition of 2,4-dichlorobenzenediazonium chloride in aqueous

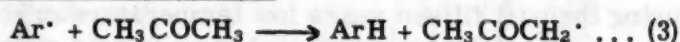
acetone were: chloroacetone, 1,3-dichlorobenzene, 1,2,4-trichlorobenzene.

The reported reduction of cupric chloride to cuprous chloride in aqueous acetone³ is probably the initiation step for a series of consecutive reactions. The second is probably a Sandmeyer decomposition of 2,4-dichlorobenzene-diazonium chloride catalyzed by cuprous chloride:

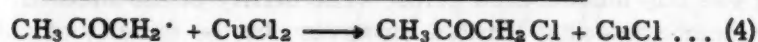


The aryl radicals formed in equation (2) then serve to explain the formation of

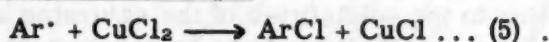
(a) 1,3-Dichlorobenzene:



(b) About 75% of the chloroacetone isolated:



(c) 1,2,4-Trichlorobenzene:



If it is assumed that equation (2) does not represent a net diminution of CuCl because it is replenished rapidly by equations (4) and (5); and also that the side reactions are first order without involving copper moieties, it is possible to derive the following equation, which gives y (the instantaneous concentration of 2,4-dichlorobenzene-diazonium chloride) as a function of time t :

$$\ln(y_0/y) = \alpha(1 - e^{-\beta t}) + \gamma t$$

where alpha, beta, and gamma can be evaluated from the data. This equation rectifies almost all the data.

Microfilm \$2.00; Xerox \$6.20. 127 pages.

1. H. Meerwein, E. Büchner and K. Van Emster, J. prakt. Chem., 152, 237 (1939).
2. W. A. Waters, J. Chem. Soc., 1937, 2007.
3. J. K. Kochi, J. Am. Chem. Soc., 77, 5274 (1955).

SOME ORTHO-CONDENSATION REACTION PRODUCTS FROM SUBSTITUTED PYRIDINEDIAMINES AND ORTHO-PHENYLENEDIAMINES

(L. C. Card No. Mic 59-2240)

Mervyn Israel, Ph.D.
University of Pennsylvania, 1959

Supervisor: Professor Allan R. Day

Various substituted imidazo-pyridines and pyrido-pyrazines were prepared as potential anti-metabolites. Their analogies with certain naturally occurring systems, notably the purines and pteridines, are discussed.

The pyridinediamines were obtained by reduction of the corresponding ortho-aminonitro compounds using a variety of reducing agents. The stannous chloride reduction of

2-amino-3-nitro-5-chloropyridine was unusual in that chlorination occurred in addition to reduction of the nitro group. A possible mechanism is discussed.

Ring closures were effected by reaction with formic acid, urea and carbon disulfide to yield the imidazoles and glyoxal, diacetyl, pyruvic aldehyde and benzil to give the pyrazines. Pyrido-pyrazines derived from 2,3-diaminopyridine-5-sulfonic acid could not be prepared, the reaction giving complex products possessing indicator properties.

Imidazo-pyridines having halogen and/or methyl groups were converted to their mono-N-oxides by the action of 1.2M peracetic acid solution. Electron-attracting substituents on the pyridine nucleus prevented N-oxidation.

Pyrido-pyrazines failed to give N-oxides under a variety of conditions probably owing to complex polyoxidation products.

Several new quinoxalines derived from 1,4-dimethoxy-ortho-phenylenediamine dihydrochloride are reported.

Imidazo-(b)-quinoxaline was found to undergo a hydrolytic ring cleavage in the presence of peracetic acid forming 2,3-diaminoquinoxaline-1,4-di-N-oxide.

Also reported are the preparations of some 2-chloromethylimidazo-(b)-pyridines and their reactions with tertiary amines.

Attempts to prepare the unknown pyrido-(b)-1,2,4-triazine system and pyridine analogs of riboflavin were unsuccessful. Microfilm \$2.00; Xerox \$6.20. 128 pages.

THE MECHANISM OF SHEAR DEGRADATION OF VINYL POLYMERS IN DILUTE SOLUTION BY HIGH SPEED STIRRING

(L. C. Card No. Mic 58-3340)

William R. Johnson, Jr., Ph.D.
University of Pennsylvania, 1958

Supervisor: Professor Charles C. Price

The degradation of polyisobutylene and polystyrene resulting from the high speed stirring of their dilute solution has been investigated.

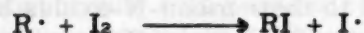
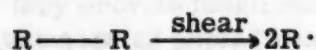
It has been shown that maximum degradation is obtained in "poor" solvents, at low temperatures and at highest possible rates of applied shear. These observations are in accord with the general pattern of all mechanical degradation.

The lower limit of the intrinsic viscosity reached for polyisobutylene in benzene solution has been found to be 1.30 as measured in cyclohexane at 30° C. For polystyrene, the lowest molecular weight reached is represented by an intrinsic viscosity of ca. 0.75 in methyl ethyl ketone at 25° C.

These polymers have been sheared in the presence of iodine and the amounts of iodine incorporated into the polymers measured radiochemically. From these measurements, it has been shown that the amounts of iodine incorporated into the polymers are of the same order of magnitude as number of polyradicals produced by shear as estimated from losses of intrinsic viscosity. The absolute magnitude of the iodine uptake however, is low compared to the values deduced from viscometry. Despite

this discrepancy, it is felt that the qualitative agreement achieved between the two methods supports the idea that shear forces cause homolytic cleavage of carbon - carbon bonds of the polymer chain yielding free radicals, which can be terminated by radical acceptors. No data have been collected to indicate the extent to which disproportionation may occur when iodine is present.

This overall reaction may be represented by the following equation:



Microfilm \$2.00; Xerox \$4.80. 95 pages.

A STUDY OF THE REDUCTION OF AROMATIC COMPOUNDS WITH LITHIUM IN AMINE SOLVENTS

Sidney Arthur Kilsheimer, Ph.D.
Purdue University, 1959

Major Professor: Dr. R. A. Benkeser

It was found that substituents such as the nitro, amino and carboxyl groups have a profound effect on the course of lithium-amine reductions of aromatic compounds.

In general nitro compounds were reduced to the corresponding anilines with very little reduction of the aromatic nucleus taking place.

Anilines containing alkyl substituents were reduced to the corresponding saturated products with the more stable cyclohexylamine isomer forming in each case. *m*-Toluidine gave *cis*-3-methylcyclohexylamine. *m*-Aminocumene and 3-*t*-butylaniline gave the corresponding *cis*-3-alkylcyclohexylamines. *p*-Aminocumene and 4-*t*-butylaniline gave the corresponding *trans*-4-alkylcyclohexylamines, and *o*-aminocumene gave *trans*-2-isopropylcyclohexylamine.

The isomeric anisic acids were reduced to the corresponding 1,4-dihydro products. Phenylacetic acid and α -phenylpropionic acid gave the corresponding 2,5-dihydro products while α -phenylisobutyric acid was reduced to a mixture of α -cyclohexylisobutyric acid and α - Δ' -tetrahydrocyclohexylisobutyric acid.

p-Cresol was reduced in good yield to 4-methylcyclohexanone. *o*-, and *m*-Cresol, 3,4-dimethylphenol and 3,5-dimethylphenol were found to reduce with difficulty.

Benzaldehyde and *p*-tolualdehyde each gave products made up of the corresponding cyclohexylcarbinols, Δ' -tetrahydrobenzyl alcohols and the corresponding tetrahydro and hexahydro-*N*-methylbenzylamines.

Microfilm \$2.00; Xerox \$5.00. 96 pages.

SOLUBILITIES OF FATTY ACIDS IN SELECTED ORGANIC SOLVENTS AT LOW TEMPERATURES

(L. C. Card No. Mic 59-2287)

Doris Kasey Kolb, Ph.D.
The Ohio State University, 1953

Low temperature crystallization constitutes one of the simplest yet most efficient methods available for separating fatty acids. The development of the technique as a means for resolving fatty acid mixtures has resulted mainly from the work of Brown and co-workers, whose first papers^{1,2} of a series on this subject appeared in 1937. These investigators worked with dilute fatty acid solutions in organic solvents and within the range of temperatures obtainable with dry ice.

During the past fifteen years low temperature crystallization has been extensively applied to problems of fatty acid separation. It has been of particular value for purifying various unsaturated acids. The utility of the method has been somewhat limited, however, by the paucity of solubility data available for fatty acids at low temperatures. Although there has been considerable information accumulated relating to the solubilities of the saturated acids at temperatures above 0°, there have been few studies concerning unsaturated acid solubilities. The first was that of Foreman and Brown,³ who investigated the solubilities of eleven different fatty acids in three organic solvents at temperatures ranging from 0° to -70°. However, only five of the acids were unsaturated, and for two of these the data were very incomplete. Moreover, equilibrium conditions were not always attained, so that some of the solubility data may not be entirely accurate. A more recent study was that of Hoerr and Harwood,⁴ who made a comprehensive investigation of the solubilities of oleic and linoleic acids in a series of organic solvents. The only other source of fatty acid solubility data at low temperatures has been the work of Singleton,^{5,6} who studied three-component systems. He investigated the solubilities of oleic-palmitic

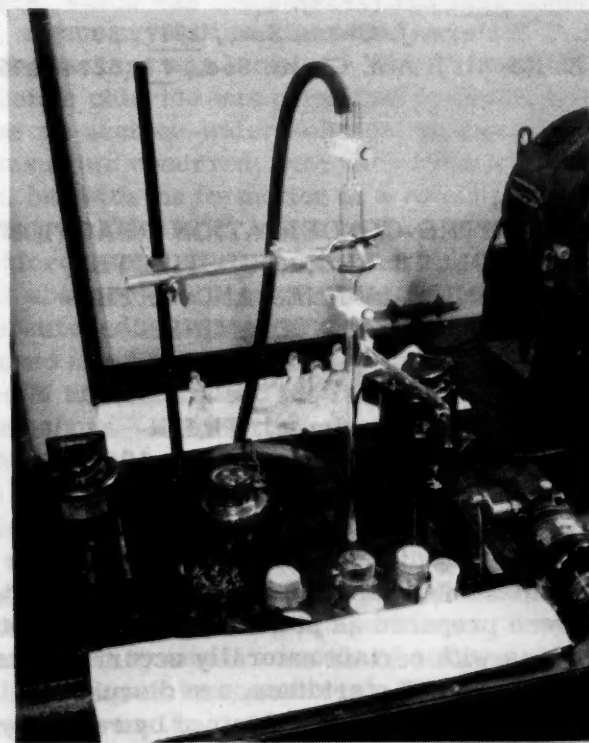


Figure 1

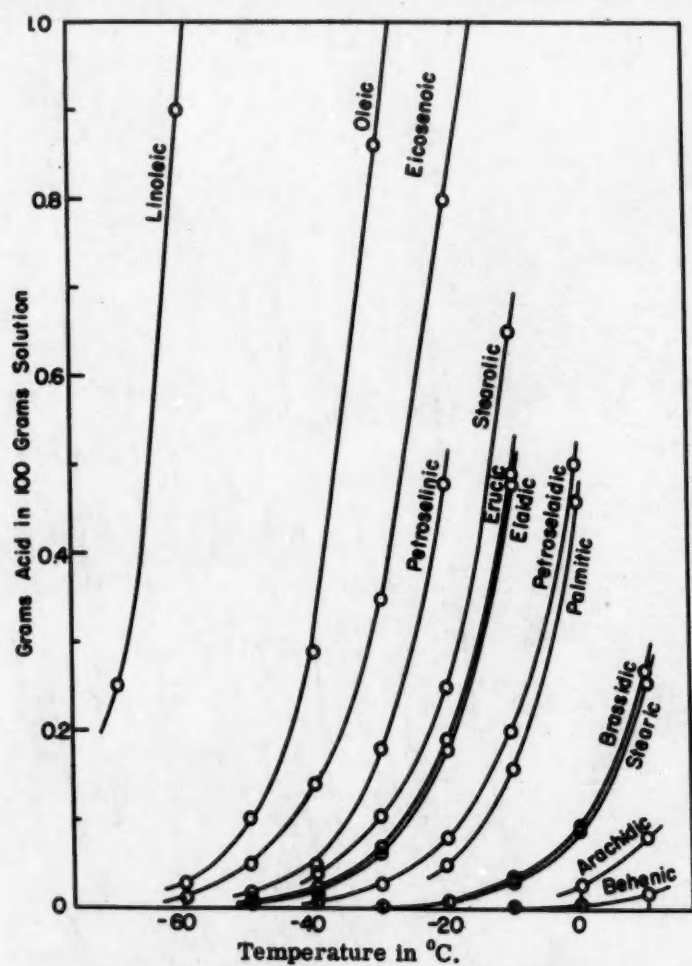


Figure 2.--Solubility of Fatty Acids in Methanol

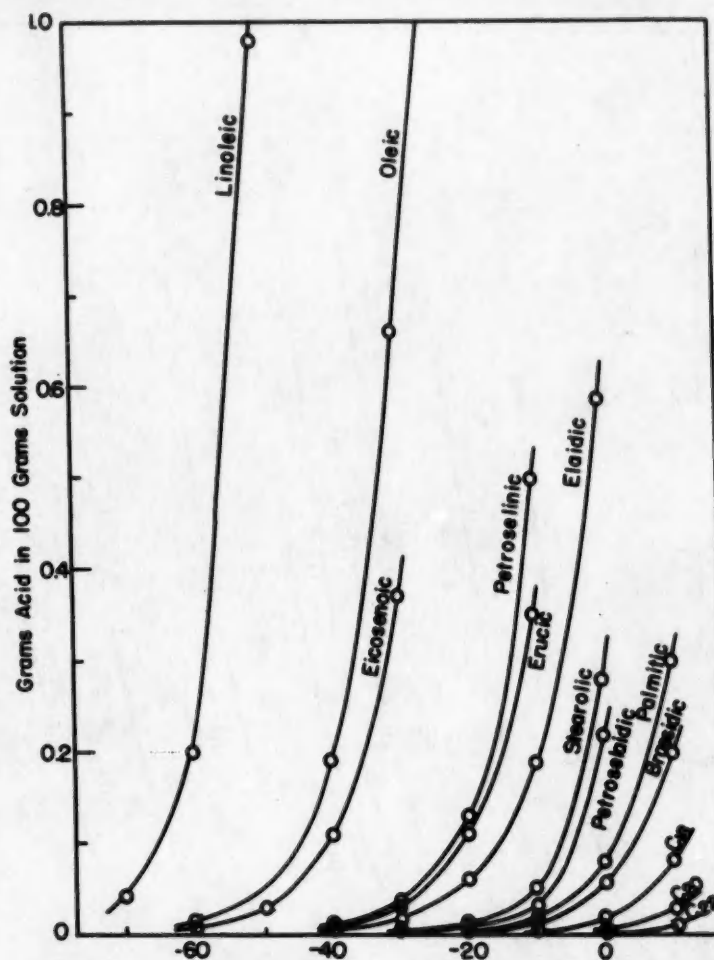
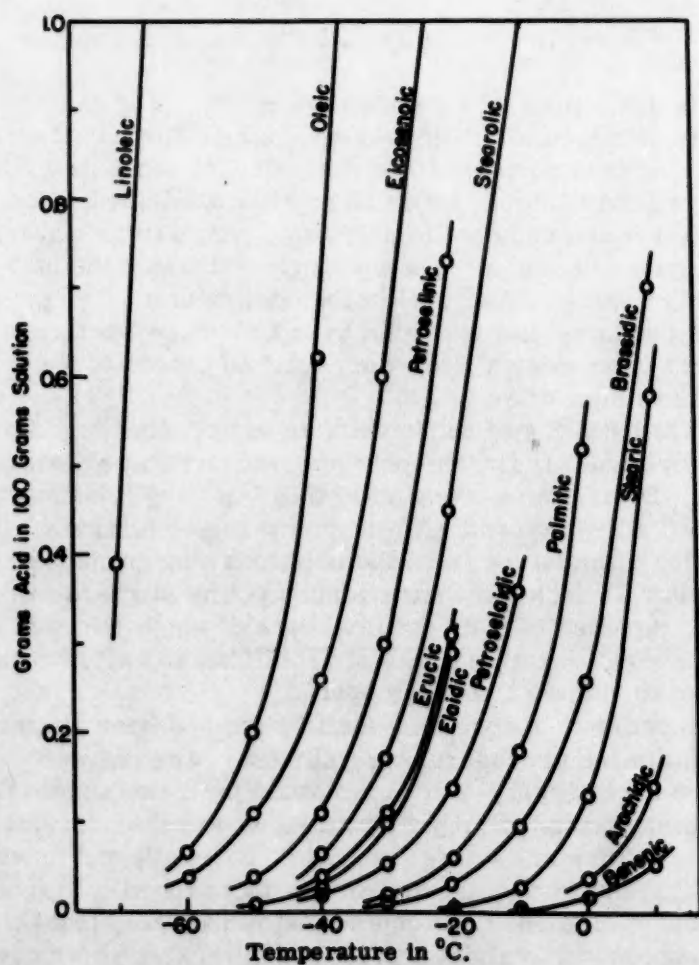
Figure 4.--Solubility of Fatty Acids in *n*-Heptane

Figure 3.--Solubility of Fatty Acids in Ethyl Acetate

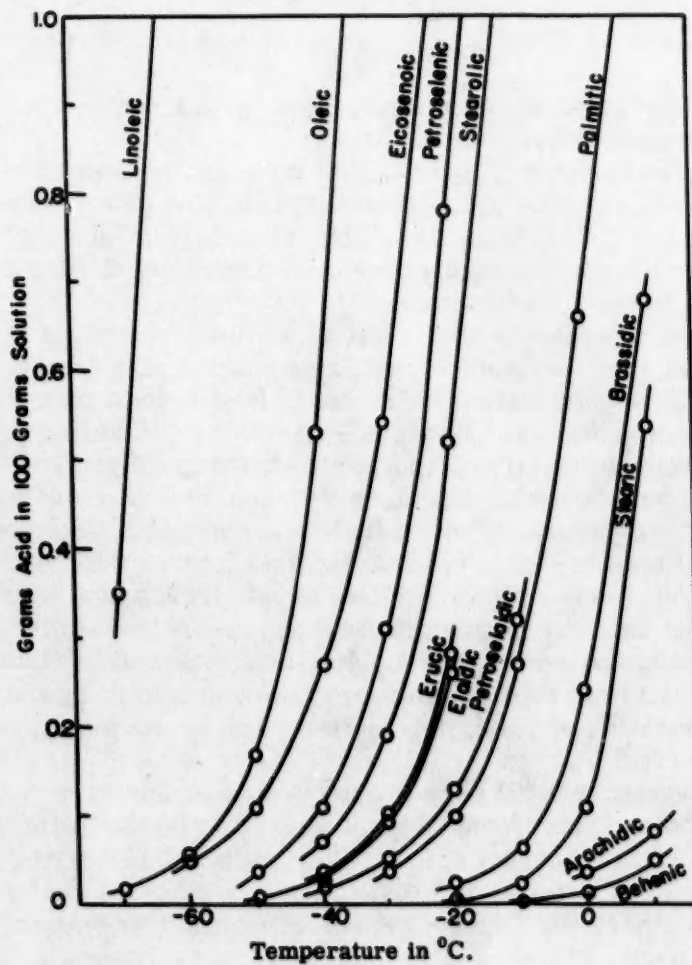


Figure 5.--Solubility of Fatty Acids in Acetone

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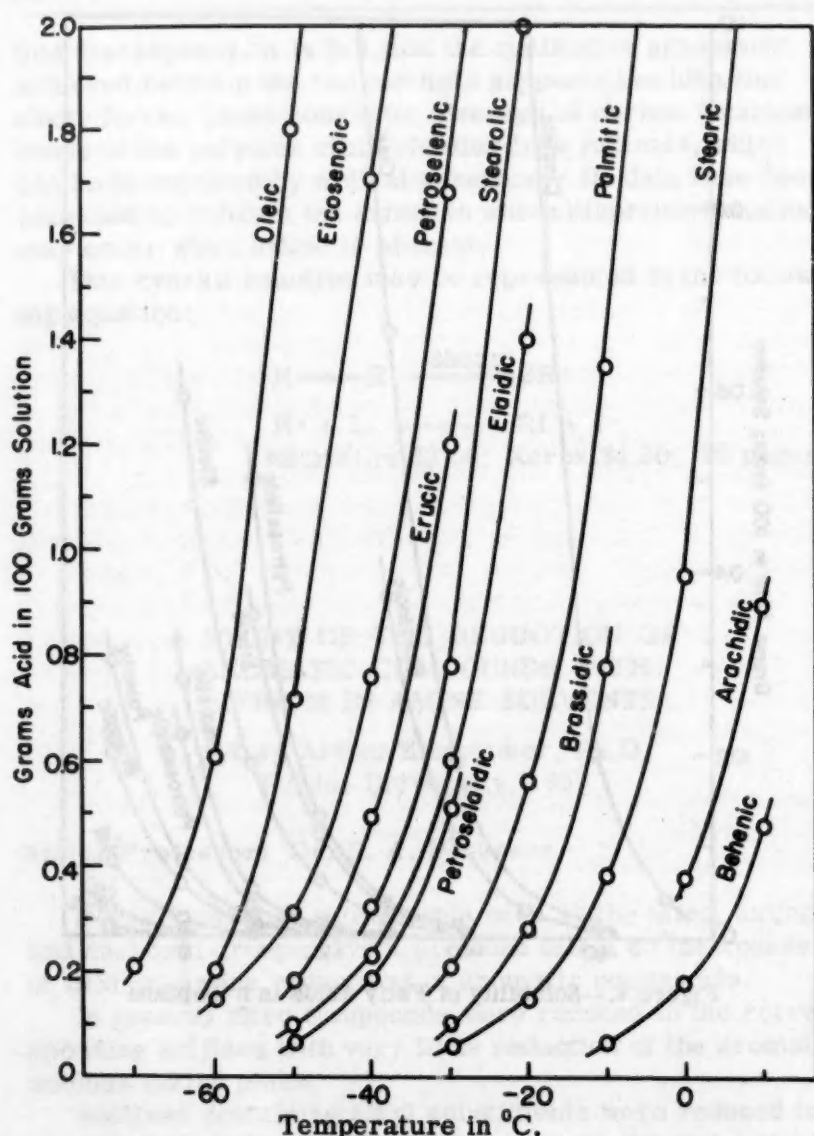


Figure 6.--Solubility of Fatty Acids in Diethyl Ether

and oleic-stearic acid mixtures both in acetone and in hexane at various low temperatures.

It has been the purpose of the investigation to carry out an extensive study of the solubility behavior of a number of highly purified fatty acids, including mainly unsaturated acids, at low temperatures and in a number of different types of organic solvents.

This problem involved first of all the preparation of the pure fatty acids themselves. The following acids were prepared by a combination of the methods of fractional methyl ester distillation and low temperature crystallization: oleic acid, from olive oil; stearic acid, from Hystrene 97-S (a commercial stearic acid); and erucic and eicosenoic acids, from rapeseed oil. Linoleic acid was prepared by crystallization of Hormel linoleic acid (obtained by debromination). Other highly purified acids already available included palmitic, arachidic, behenic, and petroselinic acids, and the synthetic acetylenic acid, stearolic. Elaidic, petroselaidic, and brassidic acids were prepared by the isomerization of oleic, petroselinic, and erucic acids, respectively.

Solvents were all pure grade chemicals and were redistilled before use. Most of them were also treated with suitable drying agents prior to distillation. The solvents selected were methanol, ethyl acetate, *n*-heptane, acetone, diethyl ether, and toluene, representing six different solvent types.

Solubilities were measured according to a modification

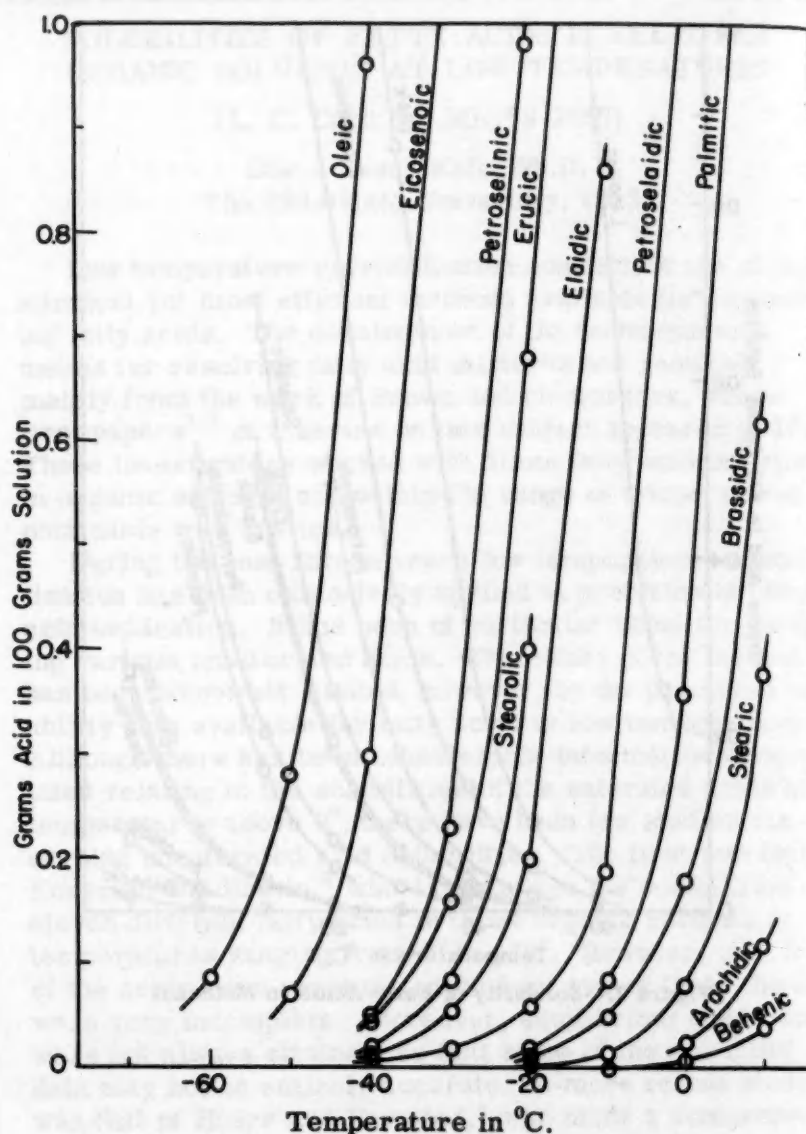


Figure 7.--Solubility of Fatty Acids in Toluene

of the procedure of Foreman and Brown. The essential parts of the constant temperature apparatus included a working compartment filled with alcohol and a separate refrigeration chamber to which dry ice was added. The thermostat in the constant temperature compartment operated by turning on and off a pump which circulated the bath liquid through a copper coil in the cooling unit. Temperature was measured and recorded by a Leeds and Northrup Model R Micromax Recorder, specially made to work at temperatures down to -75° .

The bath was of sufficient size to accommodate six 250 ml. Erlenmeyer flasks containing solvent and excess fatty acid. During the early part of this work the flasks were individually equipped with mercury-sealed stirrers. (Exclusion of moisture from the solutions was an important problem at such low temperatures.) The stirrers were later replaced by a mechanical rocker which afforded simultaneous agitation of the six solutions and allowed the flasks to remain tightly stoppered.

In order to assure that equilibrium had been attained, the following procedure was followed. Samples were withdrawn about twenty-four hours apart until two successive samples yielded the same results. It was then assumed that equilibrium had been reached. Several experiments in which the test temperature was approached both from the warm side and from the cold side indicated that this assumption was valid. A period of several days was generally adequate for attainment of equilibrium.

Table I. Solubility Data on Fatty Acids in Various Solvents
(All values in grams acid per 100 grams solution)

Tempera- tures (°C)	Solvent					
	Methanol	Ethyl Acetate	Diethyl Ether	Acetone	Toluene	n Heptane
Stearic Acid						
10	0.26	0.58	2.40	0.54	0.	0.080
0	0.090	0.13	0.95	0.11	0.080	0.018
-10	0.031	0.027	0.38	0.023	0.015	0.004
-20	0.011	0.006	0.15	0.005	0.003	-
-30	-	-	0.051	-	-	-
Oleic Acid						
-20	4.02	5.95	-	5.20	-	2.25
-30	0.86	1.90	-	1.68	3.12	0.66
-40	0.29	0.62	5.15	0.53	0.96	0.19
-50	0.10	0.20	1.80	0.17	0.28	0.050
-60	0.03	0.057	0.61	0.055	0.075	0.011
-70	-	-	0.21	-	-	-
Elaidic Acid						
0	-	-	-	-	-	0.59
-10	0.48	-	-	-	0.86	0.19
-20	0.18	0.29	1.40	0.26	0.20	0.060
-30	0.064	0.10	0.60	0.092	0.056	0.019
-40	0.020	0.027	0.23	0.029	0.013	0.007
-50	0.010	0.008	0.10	0.009	-	-
Linoleic Acid						
-50	3.10	4.40	-	4.10	-	0.98
-60	0.90	1.38	-	1.20	-	0.20
-70	0.25	0.39	-	0.35	-	0.042
Arachidic Acid						
10	0.080	0.14	0.90	0.13	0.12	0.028
0	0.028	0.036	0.38	0.035	0.026	0.005
Eicosenoic Acid						
-20	0.80	1.30	-	1.10	-	-
-30	0.35	0.60	3.90	0.54	1.10	0.45
-40	0.15	0.26	1.70	0.27	0.30	0.15
-50	0.06	0.11	0.68	0.12	0.07	0.048
-60	0.02	0.04	0.22	0.05	-	0.01
Petroselinic Acid						
-10	-	-	-	-	-	0.50
-20	0.48	0.73	3.52	0.78	0.98	0.13
-30	0.18	0.30	1.68	0.31	0.23	0.040
-40	0.060	0.11	0.76	0.11	0.046	0.009
-50	0.018	0.040	0.31	0.035	0.008	-
-60	-	-	-	-	-	-
Petroselaidic Acid						
0	0.50	-	-	-	1.40	0.22
-10	0.20	0.36	-	0.32	0.19	0.030
-20	0.082	0.14	-	0.13	0.060	0.008
-30	0.028	0.050	0.51	0.050	0.020	0.002
-40	0.010	0.018	0.19	0.019	0.008	-
-50	-	-	0.070	-	-	-
Stearolic Acid						
0	-	-	-	-	-	0.28
-10	0.65	1.15	4.85	1.26	1.70	0.050
-20	0.25	0.45	2.00	0.52	0.40	0.010
-30	0.103	0.17	0.78	0.19	0.083	0.006
-40	0.040	0.065	0.32	0.070	0.018	-

Table I. Solubility Data (Continued)
(All values in grams acid per 100 grams solution)

Tempera- tures (°C)	Solvent					
	Methanol	Ethyl Acetate	Diethyl Ether	Acetone	Toluene	n Heptane
Palmitic Acid						
10	1.30	-	-	1.60	1.41	0.30
0	0.46	0.52	2.95	0.66	0.36	0.08
-10	0.16	0.18	1.35	0.27	0.086	0.02
-20	0.050	0.060	0.56	0.10	0.018	0.005
-30	-	0.018	0.21	0.038	-	-
Behenic Acid						
10	0.019	0.055	0.48	0.050	0.040	0.012
0	0.007	0.016	0.18	0.014	0.010	0.002
-10	0.002	0.004	0.068	0.004	0.002	-
Erucic Acid						
-10	0.49	-	-	-	-	0.35
-20	0.19	0.31	-	0.28	0.68	0.11
-30	0.068	0.11	1.20	0.10	0.16	0.030
-40	0.024	0.040	0.49	0.037	0.044	0.008
-50	0.007	-	0.18	-	-	-
Brassicidic Acid						
10	0.27	0.70	-	0.68	0.62	0.20
0	0.094	0.26	-	0.24	0.18	0.058
-10	0.035	0.096	0.78	0.065	0.050	0.016
-20	0.010	0.028	0.28	0.024	0.013	0.005
-30	0.003	0.01	0.10	-	-	-

A special withdrawal pipette was designed for removing samples of saturated solution from the flasks in the constant temperature bath. Pictured in Figure 1, it consisted of a 50 ml. glass bulb equipped at both ends with two-way stopcocks and connected by a ground glass joint to a sintered glass filter tube. The filter was pushed down into the solution, a sample was drawn by suction up into the bulb of the pipette, and then, by proper manipulation of the stopcocks, it was allowed to flow into a tared, glass-stoppered flask.

The solution was weighed, the solvent removed, and the quantity of acid residue determined both gravimetrically and by titration against standardized alkali. Results were calculated as weight per cent solubilities, i.e., grams acid per 100 grams solution.

A compilation of the data obtained during the course of this work appears in Table I. The data are also presented graphically in Figures 2-7. A comparison of the data has been made with those of other investigators in those cases where previously reported values were available. In general, the agreement was very good.

A limited study was also made with a series of hydrocarbon solvents in order to note any effect of solvent structure on fatty acid solubility. The results are given in Table II. The effects were not large, but several generalizations concerning the influence of solvent structure have been drawn from the data. Cycloalkanes, for example, appear to have greater solvent power than the corresponding straight chain compounds, while solvent properties appear to be decreased slightly by such changes as increase in the chain length of the solvent molecules or introduction of neopentyl type branching.

Table II. Fatty Acid Solubilities in Various Hydrocarbon Solvents
(All values expressed in grams acid/100 grams solution)

Stearic Acid				
Temperatures (°C)	n-Heptane	Methylcyclohexane	n-Pentane	Isopentane
10	0.080	0.20	0.089	0.096
0	0.018	0.06	0.015	0.040
-10	0.004	0.021	0.003	0.017
-20	-	0.005	.-	.-
Temperatures (°C)	Diisopropyl	Neohexane	2-Methylpentane	Isooctane
10	0.070	0.04	0.086	0.051
0	0.015	0.010	0.03	0.020
-10	0.004	0.003	0.01	0.008
-20	-	-	0.003	0.003

Oleic Acid						
Temperatures (°C)	n-Heptane	Methylcyclohexane	Diisopropyl	Isooctane	Neohexane	2-Methylpentane
-40	0.19	0.34	0.212	0.162	0.13	0.19
-50	0.050	0.11	0.112	0.070	0.050	0.08

Linoleic Acid			
Temperatures (°C)	n-Heptane	Methylcyclohexane	Diisopropyl
-50	0.98	2.06	0.94
-60	0.20	0.38	0.17
-70	0.042	0.072	0.032

Examination of the curves in Figures 2-7 permits selection of optimum conditions (i.e., solvent, concentration, and temperature) for carrying out a number of fatty acid separations using the low temperature crystallization method. Oleic and elaidic acids might be separated from heptane at -20° , from methanol at -25° , from ethyl acetate, acetone, or toluene at -30° , or from ether at -40° . Conditions could be similarly chosen for separating petroselinic and petroselaidic or erucic and brassidic acids. Other typical crystallization schemes might include the separation of stearic and stearolic acids from acetone at 0° , of oleic and petroselinic acids from heptane at -20° , of stearic and elaidic acids from toluene at -10° , and of erucic and oleic acids from ethyl acetate at -10° . The efficiency of such separations will of course be limited by the extent to which the mixture is influenced by various association phenomena and intersolubilization effects.

It is hoped that the data presented here will not only fill a conspicuous gap in our knowledge of the physico-chemical behavior of these important long chain compounds, but will also serve as a guide for more profitable utilization of the method of low temperature crystallization.

Microfilm \$2.00; Xerox \$5.80. 117 pages.

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Abstract published by special arrangement with The Ohio State University.

BROMINATION AND ALKOXYLATION OF FURAN COMPOUNDS

(L. C. Card No. Mic 59-2288)

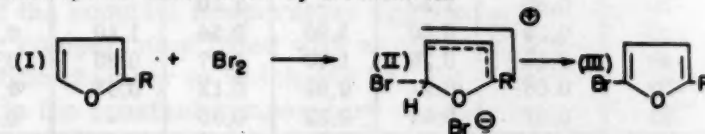
Kenneth Emil Kolb, Ph.D.

The Ohio State University, 1953

I. The reaction of furan compounds with bromine

No direct method for bromination of furan or alkylfurans by bromine has been published with the exception of the recent work of Yanouskaya.¹ He reported that the action of dioxane-dibromide complex upon furan gave an oil which he called 2-bromofuran; however, he gave no properties for the product. All of the successful preparative methods for bromofurans have involved an indirect path such as decarboxylation of the appropriate halofuroic acid.^{2,3}

A. Electrophilic substitution by bromium ion



B. Addition followed by elimination

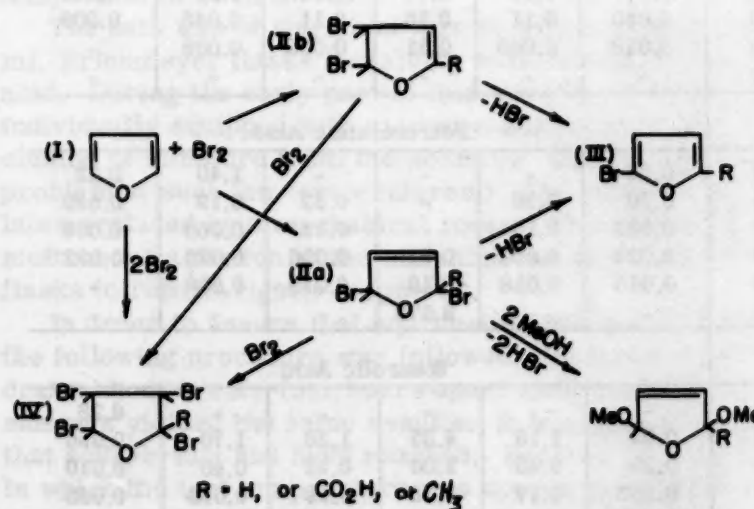


Fig. 1. Two possible mechanisms for bromination of furans

The reaction between furan and bromine is usually pictured as going by one of the two mechanisms illustrated in Figure 1. Mechanism A is the electrophilic substitution by brominium ion in which the furan (I) is attacked by a positive bromine to give (II), the transition state in which the incoming bromine and the outgoing proton are joined to the nucleus by partial sigma bonds. The loss of the proton to give 2-bromofuran (III) restores aromaticity to the furan ring. Mechanism B pictures the reaction as a 1,2- or 1,4-type addition of bromine to furan to give an unstable substance (IIa, IIb), which can, by losing hydrogen bromide from the 2,3 or 2,5 positions, give 2-bromofuran (III).

Bromination of 2-methylfuran was studied in a variety of solvents. The solvents used were diethyl ether, the petroleum ethers, carbon tetrachloride, dioxane, and pyridine. Of these solvents, pure pyridine proved to be the best solvent for the bromination of 2-methylfuran, giving a ten per cent yield of 5-bromo-2-methylfuran. A serious disadvantage of pyridine as solvent was that the reaction mixture became heterogeneous and almost solid. No effective means was found to thin the mixture except the addition of methanol, which probably lowers the yield of the desired product. An equal mixture of dioxane and pyridine gave only a four per cent yield of 5-bromo-2-methylfuran.

The 5-bromo-2-methylfuran obtained by the methods described was oxidized with potassium ferricyanide to give a 31 per cent yield of 5-bromo-2-furoic acid.

Attempts to brominate furan in diethyl ether resulted in yields as high as 15 per cent of 2,3,4,5-tetrabromotetrahydrofuran. When methanol was added to the ether and furan solution before or after the addition of bromine, 12 and 50 per cent yields respectively of 2,5-dimethoxy-2,5-dihydrofuran were obtained.

The 2,5-dimethoxy-2,5-dihydrofuran prepared by the two methods above is identical with that obtained by adding bromine in methanol to furan in a methanol-diethyl ether mixture, which is the method used by Fokstorp, et al.⁴

An examination of dioxane as a solvent for the bromination of furan was made in which one mole of bromine in dioxane was quickly added to one mole of furan in dioxane, and the mixture quenched in a few minutes by pouring it into a large amount of aqueous alkali. From the aqueous solution there was isolated a 20 per cent yield of 2-bromofuran, two per cent of 2,3,4,5-tetrabromotetrahydrofuran, and 77 per cent of the bromine as sodium bromide. When the reaction mixture was allowed to stand for several hours before quenching 22 per cent of 2-bromofuran, 2.4 g. of tar and 40 per cent of the bromine as sodium bromide was obtained. If undiluted bromine was added to furan in dioxane and the reaction quenched by pouring into aqueous alkali, 10 per cent of 2-bromofuran, 17 per cent of 2,3,4,5-tetrabromotetrahydrofuran and 45 per cent of the bromine as sodium bromide was obtained.

The bromination of furoic acid with moist bromine in chloroform at 40° gave 2,3,4,5-tetrabromotetrahydro-2-furoic acid. If the bromination mixture was poured into water at an early stage of the reaction 5-bromo-2-furoic acid was obtained. These findings are in agreement with the work of Bailey and Waggoner.⁵

All attempted Simonini reactions on furoic acid led to 5-bromo-2-furoic acid in yields of over 50 per cent.

II. Electrolytic Reactions of Furan

2,5-Dimethoxy-2,5-dihydrofuran was prepared by electrolyzing a mixture of furan in methanol with ammonium

bromide as electrolyte as described by Clauson-Kaas, et al.⁶ The product proved to be identical with the 2,5-dimethoxy-2,5-dihydrofuran prepared by the three nonelectrolytic methods previously described. The infrared absorption spectra were identical and yields of over 92 per cent of the 2,4-dinitrophenyl hydrazone of malealdehyde were obtained.

Lithium chloride and sodium bromide were found to be effective as electrolytes.

An attempt to methoxylate furan without the use of a halide as electrolyte led to the use of sodium methoxide in methanol. This experiment produced 2,5-dimethoxy-2,5-dihydrofuran in 47 per cent yield. Sodium hydroxide and potassium hydroxide proved to be as effective as electrolytes. The 2,5-dimethoxy-2,5-dihydrofuran prepared by these two electrolytic methods was identical with that prepared by the nonelectrolytic methods.

When the basic electrolytes were used, platinum and graphite were much superior to silver, nickel, iron, or copper as anodic material.

Temperature and current density seemed to have little effect upon yield within the limits used.

Electrolysis of a solution of furan in glacial acetic acid containing potassium acetate as electrolyte produced 2,5-diacetoxy-2,5-dihydrofuran, which was identical to the product Clauson-Kaas⁷ obtained by the reaction of lead tetraacetate on furan.

Attempts to methoxylate other organic compounds by the use of the basic electrolytes gave no definite products except in the case of thiophene, which gave a methoxylated compound. Microfilm \$2.00; Xerox \$4.20. 79 pages.

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Abstract published by special arrangement with The Ohio State University.

DIRECTING EFFECTS IN THE CONDENSATION OF FLUORINATED COMPOUNDS

(L. C. Card No. Mic 59-2291)

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The Ohio State University, 1953

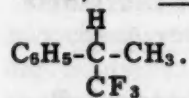
The purpose of the dissertation is to study the direction in which condensations occur when fluorinated molecules are involved, and to compare it with the direction prevailing with ordinary, non-fluorinated molecules.

The main part of the work describes three groups of reactions in which clear-cut, well-demonstrated results were obtained. In an appendix, a series of experimental results are gathered which are of interest as intermediate progress, but which are not a finished, well-rounded contribution. The three completed groups follow.

1. Study of the Friedel-Crafts reaction

The polarization of propylene is represented as $\text{CH}_3-\text{CH}=\text{CH}_2$, since H^+Cl^- is accepted to give $\text{CH}_3-\text{CHCl}-\text{CH}_3$. $\text{CF}_3-\text{CH}=\text{CH}_2$ is polarized as $\text{CF}_3-\text{CH}=\text{CH}_2$, since in accepting HCl , it gives $\text{CF}_3-\text{CH}_2-\text{CH}_2\text{Cl}$, the "reverse" addition product.¹ In the Friedel-Crafts condensation with benzene, $\text{CH}_3-\text{CH}=\text{CH}_2$ is known to give isopropyl benzene because the reaction is an electrophilic attack on benzene by the positive end of the propylene complex, $\text{CH}_3-\text{CH}^+-\text{CH}_2-(\text{AlCl}_4)^-$.

It was therefore postulated that if $\text{CF}_3-\text{CH}=\text{CH}_2$ would condense with benzene, the product should be $\text{CF}_3-\text{CH}_2-\text{CH}_2-\text{C}_6\text{H}_5$, the straight chain product, and not the branched



To determine the structure of the product actually ob-

tained, authentic samples of both isomers, $\text{C}_6\text{H}_5-\overset{\text{CF}_3}{\underset{\text{H}}{\text{C}}}-\text{CH}_3$ and $\text{C}_6\text{H}_5-\text{CH}_2-\text{CH}_2-\text{CF}_3$ were prepared for comparison. $\text{CF}_3-\text{CH}_2-\text{CH}_2-\text{C}_6\text{H}_5$ was obtained by treating benzene with $\text{CF}_3-\text{CH}_2-\overset{\text{O}}{\text{C}}-\text{Cl}$ and reducing the resulting ketone, $\text{C}_6\text{H}_5-\overset{\text{O}}{\text{C}}-\text{CH}_2-\text{CF}_3$, by the Clemmensen procedure.² $\text{C}_6\text{H}_5-\overset{\text{CF}_3}{\underset{\text{O}}{\text{C}}}-\text{CH}_3$ was prepared by a condensation between $\text{CF}_3-\overset{\text{O}}{\text{C}}-\text{CH}_3$ and $\text{C}_6\text{H}_5\text{MgBr}$ to yield the tertiary alcohol, $\text{C}_6\text{H}_5-\overset{\text{CF}_3}{\underset{\text{CH}_3}{\text{C}}}-\text{OH}$, which was easily dehalogenated to the olefin, $\text{C}_6\text{H}_5-\overset{\text{CF}_3}{\text{C}}=\text{CH}_2$; this compound was then reduced to $\text{C}_6\text{H}_5-\overset{\text{CF}_3}{\text{C}}-\text{H}$.

However, all attempts to condense $\text{CF}_3-\text{CH}=\text{CH}_2$ with benzene gave a high boiling material which did not correspond to either the straight or branched chain compounds.

It is also known that both $\text{CH}_3-\text{CHCl}-\text{CH}_3$ and $\text{CH}_3-\text{CH}_2-\text{CH}_2\text{Cl}$ react with benzene in the presence of AlCl_3 to give only the branched chain isopropyl benzene, the same product as the olefin. It is therefore logical to try the condensation of $\text{CF}_3-\text{CH}_2-\text{CH}_2\text{Cl}$ and $\text{CF}_3-\text{CHCl}-\text{CH}_2$ with benzene. This approach succeeded and in both cases gave the straight

chain derivative, $\text{C}_6\text{H}_5-\text{CH}_2-\text{CH}_2-\text{CF}_3$, as shown by comparison of the physical constants of the products and the au-

thentic samples of $\text{CF}_3-\text{CH}_2-\text{CH}_2-\text{C}_6\text{H}_5$ and $\text{C}_6\text{H}_5-\overset{\text{CF}_3}{\underset{\text{CH}_3}{\text{C}}}-\text{H}$.

A similar study on toluene showed the product was also the one with the straight side chain. In this case, it was necessary to determine the position of attack in addition to the shape of the side chain. Oxidation of the product led to p-phthalic acid; therefore, the original condensation product must have been (p) $\text{CF}_3-\text{CH}_2-\text{CH}_2-\text{C}_6\text{H}_4-\text{CH}_3$.

2. Study of the Prins reaction

Under polar conditions, $\text{CFCl}=\text{CF}_2$ accepts a reagent A^+B^- to yield $\text{ACFCl}-\text{CF}_2\text{B}$ exclusively; hydrogen bromide gives $\text{HCFCl}-\text{CF}_2\text{Br}$,¹ alcohols give $\text{HCFCl}-\text{CF}_2\text{OR}$,³ and amines give $\text{HCFCl}-\text{CF}_2\text{NR}_2$.⁴

From this data, it could be expected that, in the presence of AlCl_3 , addition of CCl_4 should yield $\text{CCl}_3-\text{CFCl}-\text{CF}_2\text{Cl}$. A report⁵ that a reversed direction had been observed, with formation of $\text{CCl}_2\text{F}-\text{CF}_2-\text{CCl}_3$ was therefore regarded as unconvincing, and on reinvestigation was proved incorrect.

When the addition was run at 35°C . in a large excess of CCl_4 and without sudden heat evolution, a trifluoride was obtained which froze between -20 and -30°C ., an indication that it was unlikely to be $\text{CCl}_2\text{F}-\text{CF}_2-\text{CCl}_3$, an isomer known not to freeze in dry ice.

The reported conclusion⁵ that addition is directed to make $\text{CCl}_2\text{F}-\text{CF}_2-\text{CCl}_3$ is based on two counts: (1) that the observed physical properties do not agree with the published constants⁶ for the alternate $\text{CCl}_3-\text{CFCl}-\text{CF}_2\text{Cl}$, and (2) that no reaction occurs with zinc, proving, therefore, that the middle group is a CF_2 group. The first count is answered by the observation that partly rearranged mixtures were being handled. The second count is now answered by successfully carrying out the zinc reaction with removal of two chlorine atoms and formation, without loss of fluorine, of an olefin, $\text{C}_3\text{F}_3\text{Cl}_3$, the oxidation of which gave only one product, monochlorodifluoroacetic acid, $\text{CF}_2\text{Cl}-\text{COOH}$. These experiments prove that the original addition compound did not carry two fluorine atoms on the central carbon, but did carry two fluorine atoms on the end carbon. Further, dehalogenation in alcohol at high temperature caused the formation of a "doubled-up molecule," $\text{CCl}_2=\text{CF}-\text{CF}_2-\text{CF}_2-\text{CF}=\text{CCl}_2$, without loss of fluorine, the oxidation of which gave $\text{HO}_2\text{C}-\text{CF}_2-\text{CF}_2-\text{CO}_2\text{H}$. This confirmed the fact that the CF_2 group is at the end of the single molecule (C_3) since otherwise two adjacent CF_2 groups could not be found in the middle of the doubled-up (C_6) molecule and the resulting diacid.

The disagreement in experimental results seems caused by the zinc dehalogenation in boiling ethanol being so exceedingly slow that it gives the impression of not proceeding at all. However, when it is performed at 100°C . in dioxane, it proceeds normally, with formation of ZnCl_2 and $\text{C}_3\text{F}_3\text{Cl}_3$ exclusively.

It can now be concluded that no abnormal addition of CCl_4 to $\text{CFCl}=\text{CF}_2$ occurs.

3. A study of peroxide promoted condensations

Haszeldine⁷ has shown that, under free radical conditions, $\text{CF}_2=\text{CF}_2$ accepts CF_3I to make $\text{CF}_3-\text{CF}_2-\text{CF}_2\text{I}$. With

$\text{CF}_2=\text{CF}_2$, there is no problem of direction in the condensation, since it can give only $\text{CF}_3-\text{CF}_2-\text{CF}_2\text{I}$.

With an asymmetrical olefin such as $\text{CF}_2=\text{CFCl}$, two directions of addition are possible, with formation of either $\text{CF}_3-\text{CF}_2-\text{CFCI}$ or else $\text{CF}_3-\text{CFCl}-\text{CF}_2\text{I}$. When the condensation occurs under polar conditions, the direction of addition can be predicted, as shown in group 2, by addition of CCl_4 to $\text{CF}_2=\text{CFCl}$ to give $\text{CCl}_3-\text{CFCl}-\text{CF}_2\text{Cl}$, but when the condensation is between free radicals, the direction cannot be predicted and has to be ascertained experimentally. Similarly, the condensation of CCl_3Br and $\text{CF}_2=\text{CFCl}$ can give either $\text{CCl}_3-\text{CF}_2-\text{CFCIBr}$ or $\text{CCl}_3-\text{CFCl}-\text{CF}_2\text{Br}$.

Originally it was decided that the dehalogenating action of zinc would distinguish between the two possibilities. $\text{CF}_3-\text{CFCl}-\text{CF}_2\text{I}$ can be transformed into $\text{CF}_3-\text{CF}=\text{CF}_2$ without loss of fluorine; conversely, $\text{CF}_3-\text{CF}_2-\text{CFCI}$ will not either react with zinc or else should give an olefin $\text{CF}_3-\text{CF}=\text{CFCl}$ with loss of fluorine. $\text{CCl}_3-\text{CFCl}-\text{CF}_2\text{Br}$ can react with zinc to give either $\text{CCl}_3-\text{CF}=\text{CF}_2$ or $\text{CCl}_2=\text{CF}-\text{CF}_2-\text{Br}$, without loss of fluorine; conversely, $\text{CCl}_3-\text{CF}_2-\text{CFCIBr}$ would have to lose fluorine to give an olefin $\text{CCl}_3-\text{CF}=\text{CFCl}$ or $\text{CCl}_2=\text{CF}-\text{CFCIBr}$.

Treatment of $\text{C}_3\text{F}_6\text{ClI}$ with zinc and alcohol gave, without loss of fluorine, a low boiling product which on treatment with chlorine gave a material which boiled at 35°C ., $n_D^{20} = 1.3041$. On this basis, it was believed that the sequence had been: $\text{CF}_3-\text{CFCl}-\text{CF}_2\text{I} \xrightarrow[\text{EtOH}]{\text{Zn}} \text{CF}_3-\text{CF}=\text{CF}_2$ (b.p. -29°C .) $\xrightarrow{\text{Cl}_2} \text{CF}_3-\text{CFCl}-\text{CF}_2\text{Cl}$ (b.p. 35°C .) and the formula claimed for $\text{C}_3\text{F}_6\text{ClI}$ was the one with the CFCI group in the middle. Haszeldine and Steele^{8,9} have claimed that this interpretation was incorrect and that the sequence is: $\text{CF}_3-\text{CF}_2-\text{CFCI} \xrightarrow[\text{EtOH}]{\text{Zn}} \text{CF}_3-\text{CF}_2-\text{CFCIH} \xrightarrow{\text{Cl}_2} \text{CF}_3-\text{CF}_2-\text{CFCI}_2$. The physical constants of the end products are as follows: $\text{CF}_3-\text{CFCl}-\text{CF}_2\text{Cl}$, b.p. = 34.7°C ., $n_D^{20} = 1.3029$; $\text{CF}_3-\text{CF}_2-\text{CFCI}_2$, b.p. = 35°C ., $n_D^{20} = 1.305$, and the isomers, which cannot be distinguished by boiling point or refractive index. Similarly, it is easy to confuse the intermediates $\text{CF}_3-\text{CF}=\text{CF}_2$ or $\text{CF}_3-\text{CF}_2-\text{CFCIH}$, which are both low boiling compounds. Haszeldine, however, subjected his compounds to infrared analysis, and states that this method distinguishes clearly between isomers. As there is no reason to doubt his experimentation, his interpretation might well be the correct one.

The critical dehalogenation with zinc was then tested on $\text{C}_3\text{F}_3\text{Cl}_4\text{Br}$ in a variety of experimental conditions. It did not proceed in the conventional fashion; in general, a vigorous reaction occurred, without loss of fluorine, but the olefin, which should have formed, presumably $\text{CCl}_3-\text{CF}=\text{CF}_2$ or $\text{CCl}_2=\text{CF}-\text{CF}_2\text{Br}$ (or a mixture), was not isolated. Believing that decomposition and polymerization were occurring, the writer decided to stabilize the original $\text{C}_3\text{F}_3\text{Cl}_4\text{Br}$ by fluorination to $\text{C}_3\text{F}_5\text{Cl}_3$ or $\text{C}_3\text{F}_6\text{Cl}_2$ before trying the zinc reaction.

The following sequence was carried out: $\text{C}_3\text{F}_3\text{Cl}_4\text{Br} \xrightarrow{\text{SbF}_3\text{Cl}_2} \text{C}_3\text{F}_5\text{Cl}_3 \xrightarrow{\text{SbF}_3\text{Cl}_2} \text{C}_3\text{F}_6\text{Cl}_2 \xrightarrow[\text{EtOH}]{\text{Zn}} \text{CF}_3-\text{CF}=\text{CF}_2$.

On this basis, the structure assigned to the original addition product was $\text{CCl}_3-\text{CFCl}-\text{CF}_2\text{Br}$, since $\text{C}_3\text{F}_6\text{Cl}_2$ cannot give $\text{CF}_3-\text{CF}=\text{CF}_2$ on treatment with zinc if it has a CF_2 group in the middle.

Miller and Howald¹⁰ repeated the condensation of CCl_3Br with $\text{CFCl}=\text{CF}_2$ and also obtained $\text{C}_3\text{F}_3\text{Cl}_4\text{Br}$; however, when they carried out the zinc in alcohol reaction, they claimed that a reduction took place instead of dehalogena-

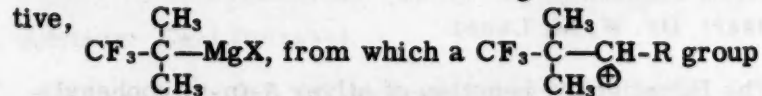
tion, and they isolated a compound $\text{C}_3\text{F}_3\text{Cl}_4\text{H}$. As this did not distinguish between the two alternates, they also proceeded to introduce more fluorine into the molecule, but used HgF_2 instead of SbF_3 as the fluorinating agent. They found, mostly by infrared analysis, that the hexafluoride was $\text{CF}_2\text{Cl}-\text{CF}_2-\text{CF}_2\text{Cl}$, and that this would not react with zinc to give $\text{CF}_3-\text{CF}=\text{CF}_2$. They were, therefore, forced to conclude that the original material, $\text{C}_3\text{F}_3\text{Cl}_4\text{Br}$, had a CF_2 in the middle and must have been $\text{CCl}_3-\text{CF}_2-\text{CFCIBr}$.

When the data were compared, it appeared at once that in one of the cases, a rearrangement had occurred during the fluorination, $\text{C}_3\text{F}_3\text{Cl}_4\text{Br} \rightarrow \text{C}_3\text{F}_6\text{Cl}_2$; it was agreed that SbF_3 was more likely to bring about rearrangement than HgF_2 , but this was frankly a matter of intuition with both parties, not a proof.

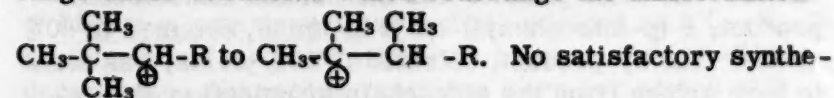
A new approach to the problem was tried when it was found that some compounds could be dehalogenated with vigor and ease when acetic anhydride was used as the solvent; and since this solvent has no protonic hydrogen it was reasoned that no reduction of the intermediate organozinc compound would occur. This would avoid the trouble experienced by Miller and Howald.¹⁰ A first attempt gave only tar, but when CH_2Cl_2 was added to the solvent it kept the reaction temperature down to 40°C . by reflux, and a "doubled-up" compound was formed without loss of fluorine which was shown to be $\text{C}_6\text{F}_6\text{Cl}_6$ by analysis. This could be only $\text{CCl}_3-\text{CFCl}-\text{CF}_2-\text{CF}_2-\text{CFCI}-\text{CCl}_3$ or $\text{CCl}_3-\text{CF}_2-\text{CFCI}-\text{CFCI}-\text{CF}_2-\text{CCl}_3$, and consequently it did not solve the problem of the original direction of addition. However, further reaction with zinc in the conventional alcohol solvent would not proceed at 78°C ., and this indicated that the compound was unlikely to be $\text{CCl}_3-\text{CClF}-\text{CF}_2-\text{CF}_2-\text{CFCI}-\text{CCl}_3$. At 100°C ., in a steel bomb, dehalogenation did occur without loss of fluorine, and an olefin $\text{C}_6\text{F}_6\text{Cl}_6$ was obtained. Since only two chlorine atoms were lost per molecule, it appears that the structure of this olefin is $\text{CCl}_3-\text{CF}_2-\text{CF}=\text{CF}-\text{CF}_2-\text{CCl}_3$ obtained from $\text{CCl}_3-\text{CF}_2-\text{CFCI}-\text{CFCI}-\text{CF}_2-\text{CCl}_3$. The original addition compound must therefore have been $\text{CCl}_3-\text{CF}_2-\text{CFCIBr}$, and the direction claimed by Haszeldine^{8,9} and by Miller¹⁰ is confirmed. A confirmation of the structure of the olefin will be carried out by oxidation to $\text{CCl}_3-\text{CF}_2-\text{CO}_2\text{H}$, a new compound which can also be made from an available sample of $\text{CCl}_3-\text{CF}_2-\text{CCl}=\text{CCl}_2$.

The minor groups collected in the appendix follow.

a) A series of reactions were carried out aimed at the production of $\text{CF}_3-\text{CX}(\text{CH}_3)_2$. This type of compound was wanted for transformation into an organometallic derivative,



could be prepared; this group was expected not to rearrange under conditions which rearrange the unfluorinated



No satisfactory synthesis for $\text{CF}_3-\text{CX}(\text{CH}_3)_2$ was found.

b) A study of possible allylic rearrangements during fluorination showed that the rearrangement of $\text{CF}_2\text{Cl}-\text{CF}=\text{CF}_2$ to $\text{CF}_3-\text{CF}=\text{CFCl}$ could be avoided. This information was needed in view of the known rearrangement of $\text{CCl}_3-\text{CF}_2\text{Cl}=\text{CF}_2$ to $\text{CCl}_3-\text{CF}=\text{CCl}-\text{CF}_3$.¹¹

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SOME STUDIES OF THE HUNSDIECKER REACTION

(L. C. Card No. Mic 59-2359)

Donovan Lee Kvalnes, Ph.D.
University of Minnesota, 1959

Adviser: Dr. W. M. Lauer

The Hunsdiecker reaction of silver β -(p-nitrophenyl)-propionate has been investigated, two products being obtained. The main product was the normal Hunsdiecker product, β -(p-nitrophenyl)-ethyl bromide, obtained in 60% yields. The by-product, obtained in 20% yields, was found to have arisen from the side-chain bromination of β -(p-nitrophenyl)-ethyl bromide. The by-product was converted to p-nitrophenacyl bromide. This suggests that the by-product was α, α, β -tribromo-p-nitroethylbenzene.

Silver γ -(p-nitrophenyl)-butyrate underwent the Hunsdiecker reaction and gave only the expected product, γ -(p-nitrophenyl)-propyl bromide, in 80% yields, an authentic sample of which was prepared.

The Hunsdiecker reaction of silver δ -(p-nitrophenyl)-valerate produced a bromide in 60 to 75% yields and an ester in 8 to 12% yields, depending on the reaction condi-

tions. The bromide was shown to be the expected δ -(p-nitrophenyl)-butyl bromide by its conversion to the known δ -(p-nitrophenyl)-valeric acid. It is supposed that the ester was δ -(p-nitrophenyl)- δ -valerolactone.

ϵ -(p-Nitrophenyl)-amyl bromide was produced in 80% yields by the Hunsdiecker reaction of silver ϵ -(p-nitrophenyl)-caproate. The bromide was converted into ϵ -(p-nitrophenyl)-caproic acid. An unknown by-product, produced in almost negligible amounts (ca. 2%), was found to result from the bromination of the main product, followed by further reaction in the presence of activated alumina, to give a p-nitrophenylalkane.

In the Hunsdiecker reaction of silver ϵ -phenylcaproate, the chief product was 5-phenylamyl bromide. Vapor phase chromatographic analysis showed that no 1-phenylamyl bromide was present. Authentic samples of 5-phenylamyl bromide and 1-phenylamyl bromide were prepared.

The Hunsdiecker reaction intermediate, ϵ -phenylcaproyl hypobromite, was prepared and decomposed thermally. The only non-acidic bromide formed was 5-phenylamyl bromide. The main acidic component was ϵ -p-bromophenylcaproic acid, indicating that ring bromination occurred, perhaps intramolecularly.

These results, when compared with the results of the thermal decomposition of ϵ -phenylcaproyl peroxide by Grob and Kammuler (1), indicate that in the Hunsdiecker reaction of silver ϵ -phenylcaproate, the mechanism of the decomposition of the intermediate hypobromite does not involve free radicals as generally supposed (2).

The author suggests that in the case of ϵ -phenylcaproyl hypobromite, the mechanism of decomposition may be either a bimolecular displacement or an intramolecular 1, 3-shift, both mechanisms having been previously proposed (2).

In general, the Hunsdiecker reaction may involve several mechanisms: a free radical mechanism, a bimolecular displacement and an intramolecular displacement. The path would be dependent upon the reaction conditions and the nature of the particular compound under investigation.

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n-BUTYLATION OF DURYL KETONES BY THE ACTION OF n-BUTYL LITHIUM

(L. C. Card No. Mic 59-2032)

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University of Illinois, 1959

Hindered aromatic ketones such as duryl phenyl ketone are particularly well suited to test the capacity of an organometallic compound to bring about conjugate addition and have been used with a number of Grignard reagents. The few organolithium reagents that have been employed with such ketones are aromatic in type. The addition of these reagents was found to occur in the 1,2- as well as the 1,4-manner.

The first aliphatic organolithium compound to be examined was *n*-butyllithium. It reacted with duryl *o*-tolyl ketone to bring about metalation of the methyl group of the tolyl radical. Carbonation converted this substance into *o*-duroylphenylacetic acid. A neutral ketone was also detected.

In the current investigation, 1,6-addition has been realized with duryl *o*-tolyl ketone, duryl phenyl ketone, and mesityl α -naphthyl ketone. Duryl *o*-tolyl ketone furnished the aromatic product, duryl 2-methyl-4-*n*-butylphenyl ketone, directly. With duryl phenyl ketone, both duryl 4-*n*-butylphenyl ketone and duryl 2-*n*-butylphenyl ketone were obtained after dehydrogenation of the crude product. A dihydro-compound was isolated from the reaction mixture obtained from mesityl α -naphthyl ketone. The dihydro derivative, when dehydrogenated over palladium-charcoal, gave an aromatic compound which is presumed to be 1-mesityl-4-*n*-butyl-naphthalene.

Duryl 2-*n*-butylphenyl ketone was synthesized by displacement of the methoxyl group from duryl 2-methoxyphenyl ketone by the action of the Grignard reagent prepared from *n*-butyl bromide.

The preparation of duryl 4-*n*-butylphenyl ketone was accomplished by the Friedel-Crafts acylation of durene by 4-*n*-butylbenzoyl chloride.

Duryl 2-methyl-4-*n*-butylphenyl ketone was prepared by the action of the methyl Grignard reagent on duryl 4-*n*-butylphenyl ketone.

In a search for the optimum conditions for the conjugate addition of the methyl Grignard reagent to duryl 4-*n*-butylphenyl ketone, the reaction mixture was heated in refluxing anisole for twenty-four hours. Durene and an unidentified phenolic material were isolated. A possible structure of this material is discussed.

The failure of an attempted methoxyl displacement by the action of *n*-butyllithium lends support to the assumption that coordination plays an important part in this reaction.

To explore the difference in reactivity between lithium and magnesium reagents, an attempt was made to condense the *n*-butyl Grignard reagent with duryl phenyl ketone. Starting ketone was recovered unchanged.

In an attempt to prepare duryl 4-*n*-butylphenyl ketone by the acylation of *n*-butylbenzene by duroyl chloride, a compound was isolated which has the characteristics of an ester of duroic acid. A possible structure and a mode of formation of this compound are discussed.

Microfilm \$2.00; Xerox \$4.20. 78 pages.

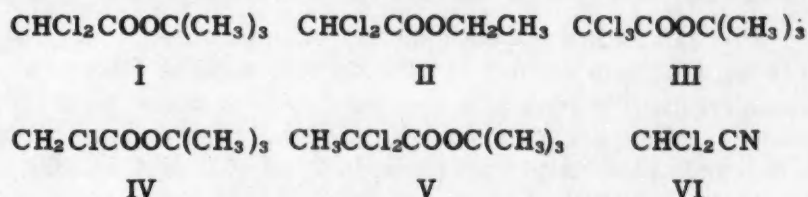
CARBENES FROM α -HALOESTERS

(L. C. Card No. Mic 59-2360)

Frederic Christian Loew, Ph.D.
University of Minnesota, 1959

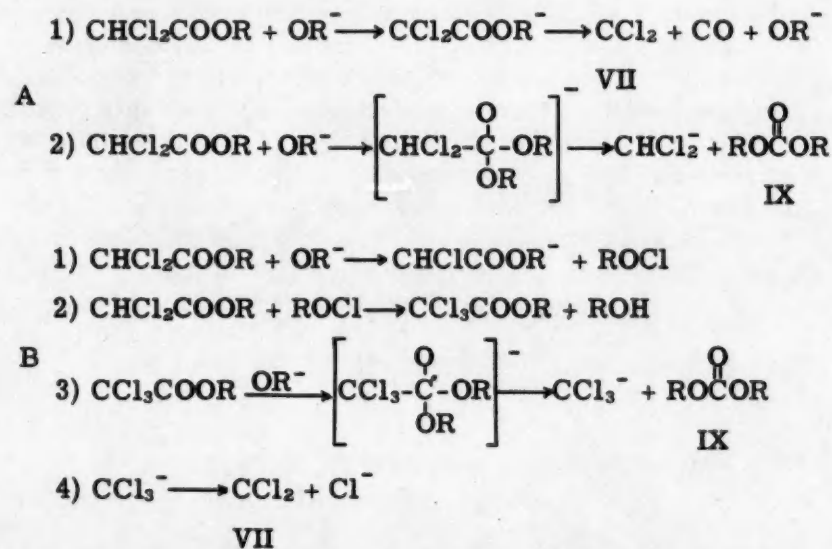
Adviser: W. E. Parham

The reaction of *tert*.-butyl dichloroacetate (I), ethyl dichloroacetate (II), *tert*.-butyl trichloroacetate (III), *tert*.-butyl chloroacetate (IV), *tert*.-butyl α,α -dichloropropionate (V), and dichloroacetonitrile (VI) with potassium *tert*.-butylate in the presence of a carbene acceptor (isobutylene) has been studied.



It has been shown that dichlorocarbene (VII) is an intermediate in the reactions of I, II and III with base, but apparently is not an intermediate in the reactions of IV, V and VI.

The formation of dichlorocarbene (VII) and dialkyl carbonate (IX) from alkyl dichloroacetates may be rationalized in terms of reaction routes A and B:



Consideration of the experimental data has led to the conclusion that B, rather than A, is the correct reaction path.

Microfilm \$2.00; Xerox \$5.00. 96 pages.

PART I: STUDIES ON THE INSECTICIDAL PRINCIPLE OF *MAMMEA americana* L.

PART II: CACTUS ALKALOID STUDIES.

(L. C. Card No. Mic 59-1364)

Swiatopolk Peter Marfey, Ph.D.
Wayne State University, 1956

Adviser: Carl Djerassi

PART I

Mammein, an insecticidal principle found in the seeds of *Mammea americana* L. was characterized as a $\text{C}_{22}\text{H}_{28}\text{O}_5$ compound and was converted to a number of crystalline derivatives. Numerous reactions were performed with mammein and its derivatives mainly to establish the nature of the functional groups. An alkali cleavage of mammein led to the isolation of methyl *n*-propyl ketone and a methylated acidic degradation product $\text{C}_{10}\text{H}_{24}\text{O}_4$. An analogous degradation product $\text{C}_{10}\text{H}_{26}\text{O}_4$ was obtained from dihydro-mammein. The reactions with alcoholic alkali resulted in formation of the isomeric compounds — isomammein, isomammein diacetate, and isomammein dimethyl ether. Treatment of mammein and mammein dimethyl ether with methanolic sulfuric acid led to new compounds, while

dihydromammein remained unchanged under the same conditions. Lithium aluminum hydride reduction of mammein dimethyl ether produced a compound, with a phenolic or enolic hydroxy group, which was methylated to a trimethoxy compound of the empirical formula $C_{25}H_{38}O_5$ or $C_{18}H_{22}O_4$. The vacuum distillation or acid treatment of the crude reduction product caused dehydration with the concomitant formation of a possible pyran or dihydrofuran structure. An extensive use was made of chromatographic techniques and of ultraviolet and infrared spectroscopy in the course of this investigation.

PART II

Several giant cacti of the subtribe *Cereanae* have been investigated. *Lophocereus australis* and *L. gatesii* were shown to contain an alkaloid, pilocereine, which was isolated in crystalline form using extraction, chromatographic, and countercurrent distribution techniques. The remaining four species, *Machaerocereus eruca*, *Cephalocereus senilis*, *Pachocereus chrysomallus*, and *Ferocactus wislizeni* did not contain alkaloids in appreciable quantities, but were shown to be rich in acidic and neutral substances.

Microfilm \$2.00; Xerox \$7.00. 147 pages.

THE SYNTHESIS OF PEPTIDES WITH PTHALYL AMINO ACIDS

(L. C. Card No. Mic 59-1365)

Mario Anthony Marini, Ph.D.
Wayne State University, 1956

Supervisor: Dr. Lawrence J. Schroeder

For quite some time this laboratory has been interested in the browning reaction which is due to the interaction of proteins and carbohydrates. For these studies, it was thought that the best approach would be through an investigation of various model systems of peptides and carbohydrates. The peptides used were synthesized by means of the "phthalyl method" since this was apparently the most convenient and economical of the many synthetic procedures reported in the literature. Because of the various difficulties encountered in the synthesis of peptides by this method, it was decided to investigate this method more thoroughly.

The phthalyl derivatives of the amino acids are easily prepared, either by heating a dry mixture of phthalic anhydride and the amino acid, or by refluxing this mixture in glacial acetic acid or pyridine. The yields of the pure stable crystalline products range from 70-95%. Phthalyl derivatives of fifteen of the naturally occurring amino acids were prepared. The phthalyl derivatives of arginine, cysteine, cystine, serine, and proline were not formed but various derivatives of these amino acids will react with phthalic anhydride.

Activation of the carboxyl group of the phthalyl derivative by means of phosphorus pentachloride in acetyl chloride proceeds in excellent yield with very little decomposition. While many of the generated phthalylamino acyl chlorides are oils, they are capable of reacting with amino groups as was shown by the formation of the anilides in

near quantitative yield. Peptide formation via the acid chloride generally proceeds poorly due to an hydrolysis of the phthalylamino acyl chloride to the corresponding phthalylamino acid which results in poor yields of the phthalyl peptide.

Activation of the carboxyl group by means of the mixed anhydrides is most satisfactorily accomplished with ethyl chlorocarbonate. The mixed anhydride could not be formed with diphenyl ketene or mesitylphenylketene. The mixed anhydride formed with isovaleryl chloride and diphenylacetyl chloride reacts with aniline to form the anilides in excellent yield; however, synthesis of peptides is unsatisfactory because of the difficulty encountered in their purification.

The formation of phthalyl dipeptides may be accomplished in excellent yields when the phthalyl derivatives of glycine, β -alanine, or phenylalanine are used. The phthalylphenylalanyl dipeptides were oils which were identified, after hydrazinolysis, as the free dipeptides. The yield and purification of the phthalyl dipeptides could be improved if the carboxyl group were esterified with thiophenol. These derivatives are stable and crystalline and offer the further advantage that they will react with another amino acid to form, in this case, the phthalyl tripeptide although the yields are generally poor.

Tripeptides of phthalylglycylmethionine and phthalyl- β -alanylmethionine were made by the mixed anhydride procedure and the yields were satisfactory. The phthalyl tripeptides formed by the use of the carbothiolic acid esters are identical with those formed from the mixed anhydride method.

Hydrazinolysis of the phthalyl peptides proceeded smoothly and in excellent yield to give the free dipeptide. All reactions apparently take place with very little or no racemization, except with a few amino acids.

With the carboxyl activators studied, the phthalyl method appears to be limited, however from the results obtained, it would be well to investigate the method further.

Microfilm \$2.00; Xerox \$6.40. 133 pages.

THE SYNTHESIS AND SOME REACTIONS OF DIAZOCYCLOBUTANE

(L. C. Card No. Mic 59-2036)

Donald Edward McGreer, Ph.D.
University of Illinois, 1959

Solutions of diazocyclobutane in toluene, toluene-ethanol, ether-ethanol, tetrahydrofuran-methanol and trans-2-butene-ethanol have been prepared by the reaction at -40° of N-cyclobutyl-N-nitrosourea with lithium ethoxide or sodium methoxide. Diazocyclobutane is red in color and is stable in solution for several hours at -40° , but decomposes in 30 min. at -15° . Reaction of diazocyclobutane with benzaldehyde gave cyclobutyl phenyl ketone in a yield of 16% based on the N-cyclobutyl-N-nitrosourea used. The cyclobutyl phenyl ketone was identified by comparison of its infrared spectrum with that of an authentic sample and by a mixture melting point of the 2,4-dinitrophenylhydrazones.

Diazocyclobutane reacted with p-phenylazobenzoic acid in toluene-ethanol to give a 20% yield of ester product

which contained cyclobutyl *p*-phenylazobenzoate (44%) and cyclopropylcarbinyl *p*-phenylazobenzoate (56%). In ether-ethanol, diazocyclobutane reacted with *p*-phenylazobenzoic acid to give a 30% yield of solid product which contained the cyclobutyl ester (28%), the cyclopropylcarbinyl ester (29%), the ethyl ester (27%) and non ester products (16%). In tetrahydrofuran-methanol, diazocyclobutane reacted with *p*-phenylazobenzoic acid to give a 9% yield of a red oil which contained the cyclobutyl ester (20%), the cyclopropylcarbinyl ester (14%), ω -cyclobutoxybutyl *p*-phenylazobenzoate (40%), ω -cyclopropylcarbinoxybutyl *p*-phenylazobenzoate (14%), and unidentified products (12%).

Chromatographic separation on alumina of the reaction mixtures made possible the isolation of the individual esters. The cyclobutyl, cyclopropylcarbinyl and ethyl *p*-phenylazobenzoate esters were identified by comparison of the infrared spectra with those of authentic samples. The ω -cyclobutoxybutyl and ω -cyclopropylcarbinoxybutyl *p*-phenylazobenzoates were identified by their analyses and n.m.r. spectra.

The observation that cyclobutyl and cyclopropylcarbinyl esters were formed in these reactions indicates that carbonium ion intermediates were formed. The carbonium ions could react with the alcohol, ether or acid anion. Reaction with ethyl ether would give an oxonium salt from which the ethyl ester could be formed. A similar oxonium salt with a tetrahydrofuran unit would give rise to the ω -cyclobutoxybutyl and ω -cyclopropylcarbinoxybutyl esters.

The reaction of diazocyclobutane with ethyl acrylate gave an oil which was assumed to be 3-carboethoxy-5-trimethylenepyrazoline. Pyrolysis of this oil gave a colorless liquid (50% based on the ethyl acrylate used) which contained ethyl *trans*- β -cyclobutylacrylate (52%) ethyl *cis*- β -cyclobutylacrylate (13%) and ethyl spirohexane-1-carboxylate (30%). These esters were separated by vapor chromatography and the yields are based on the areas under the respective peaks in the chromatogram. The esters were identified by their analyses and n.m.r. spectra.

Irradiation of diazocyclobutane in *trans*-2-butene and ethanol gave a mixture which was shown by vapor chromatography to contain two components. The mixture had an analysis, and infrared and n.m.r. spectra consistent with the assumption that it was a mixture of cyclobutyl and cyclopropylcarbinyl ethyl ethers. The yield of the mixture of ethers was 27% based on the *N*-cyclobutyl-*N*-nitrosourea used and determined from areas under peaks in the vapor chromatogram of the reaction product. There were other minor products from this reaction but none could be shown to contain a unit formed from *trans*-2-butene.

A mixture of cyclobutyl and cyclopropylcarbinyl ethyl ethers was similarly shown to be formed during the preparation of diazocyclobutane. A solution of diazocyclobutane in ether was divided into two portions. One portion was reacted with benzaldehyde and the other was allowed to decompose thermally. The yield of ethers, as calculated from the areas under the peaks in a vapor chromatogram was 6% (based on the *N*-cyclobutyl-*N*-nitrosourea used) for each portion. The ethers are therefore formed during the preparation of diazocyclobutane. A possible scheme by which this could happen is for *N*-cyclobutyl-*N*-nitrosourea to react with base to form cyclobutyldiazonium oxide which could by a concerted elimination give diazocyclobutane or by protonation give cyclobutyldiazonium hydroxide. Dissociation of the cyclobutyldiazonium hydroxide would give carbonium ions which could react with the ethanol present to form cyclobutyl and cyclopropylcarbinyl ethyl ethers.

No evidence was found to determine whether the high yield of the ethers in the photolysis experiment was due to the reaction of trimethylene carbene with ethanol.

Microfilm \$2.00; Xerox \$6.00. 123 pages.

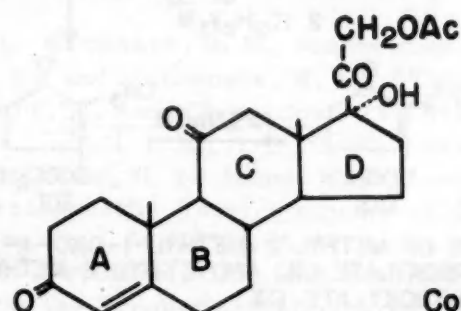
PART I. THE SYNTHESSES AND REACTIONS
OF METHYL 2-METHYL-3-OXO-1-CYCLOPENTENE-1-CARBOXYLATE AND
ETHYL 2-METHYL-3-OXOCYCLOPENTANE-CARBOXYLATE. PART II. A STUDY OF THE
REACTIONS OF GRIGNARD REAGENTS
WITH ESTERS OF LEVULINIC ACID.

(L. C. Card No. Mic 59-2299)

James Louis McPherson, Ph.D.
The Ohio State University, 1953

Part I

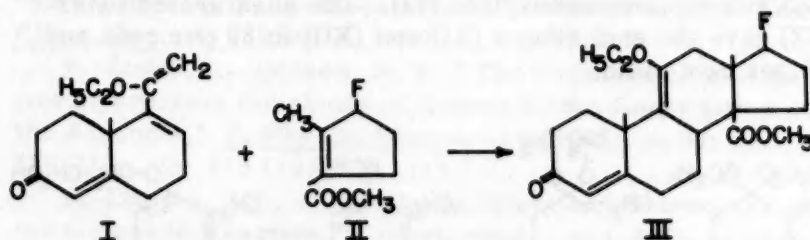
The first part of the dissertation is concerned with a proposed synthesis^{1,2,3} of cortisone.⁴



Cortisone Acetate
Structure A

The purpose was to synthesize ring D or an analogue of it and bring about a new ring C and D fusion.

On the basis of the stereospecificity of the Diels-Alder reaction a route of synthesis was proposed which involved the Diels-Alder condensation of 5-(1-ethoxyvinyl)-4, 4a, 7,8-tetrahydro-4a-methyl-2(3H)-naphthaleneone (I) with II where F is an acetal or the cortisone side chain (C-17).



To test this proposed route of synthesis it was decided to make methyl 2-methyl-3-oxo-1-cyclopentene-1-carboxylate and to mask the ketone by formation of an acetal or by introduction of the cortisone side chain. A Diels-Alder reaction of such a compound with various simpler dienes as butadiene, 2,3-dimethylbutadiene and 2-methoxybutadiene would show if II is capable of acting as a dieneophile.

Acetal Formation

The acetal formation was the first method used to try to block the ketone group and thus to neutralize its polar effect in directing the course of the proposed Diels-Alder reaction.

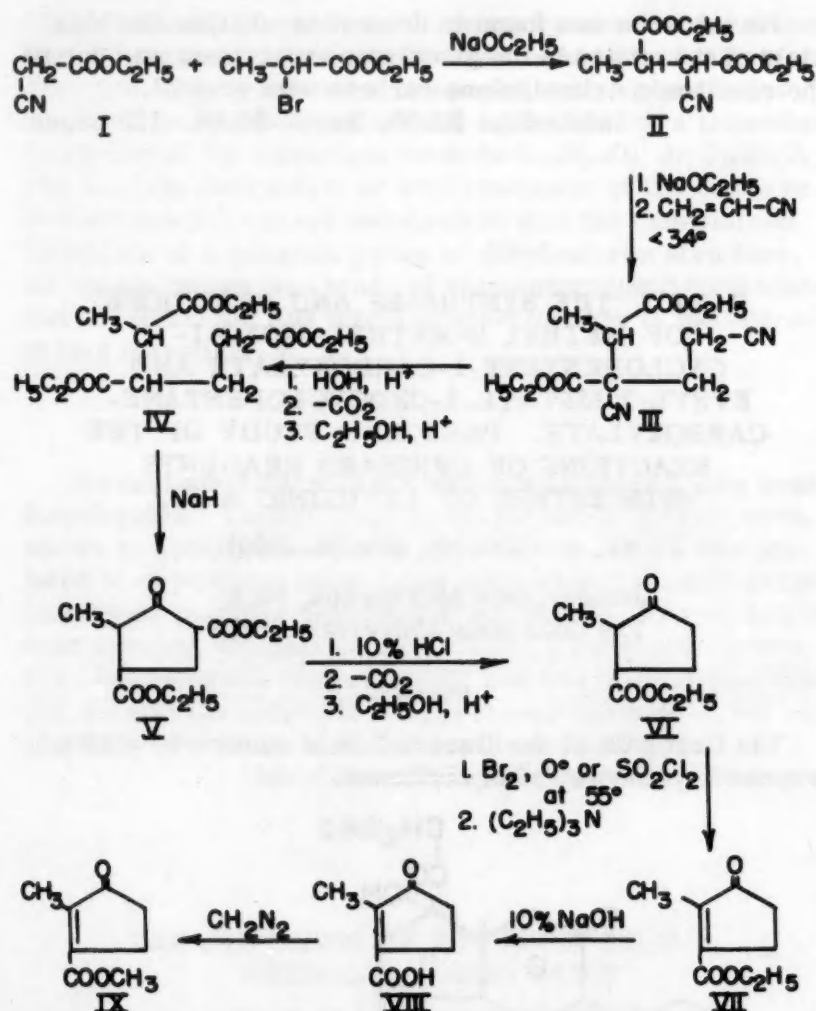
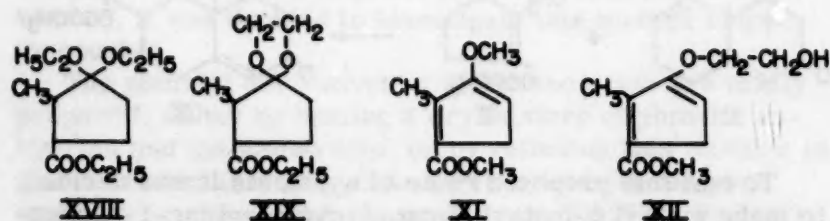


FIGURE 3 - SYNTHESIS OF METHYL 2-METHYL-1-OXO-1-CYCLOPENTENE-1-CARBOXYLATE (IX) AND ETHYL 2-METHYL-3-OXOCYCLOPENTANECARBOXYLATE (XVI)

The saturated ester (VI) gave the expected acetals, (XVIII) and (XIX). The diethyl acetal of ethyl 2-methyl-3-oxocyclopentanecarboxylate (XVIII) was formed in 86 per cent yield by the reaction of triethyl orthoformate with the saturated ester, ethyl 2-methyl-3-oxocyclopentanecarboxylate (VI). The ethylene acetal of ethyl 2-methyl-3-oxocyclopentanecarboxylate (XIX) was formed in 81 per cent yield by the reaction of ethylene glycol with the ethyl 2-methyl-3-oxocyclopentanecarboxylate (VI). The unsaturated ester (IX) gave the enol ethers (XI) and (XII) in 89 per cent and 83 per cent yield.



Ethynylation

Since the unsaturated ester, methyl 2-methyl-3-oxo-1-cyclopentene-1-carboxylate (IX) formed enol ethers (XI) and (XII) instead of the expected acetals, it was decided to try blocking the ketone by ethynylation. Two methods (with conditions varied) of ethynylation were tried: (a) sodium, liquid ammonia, and acetylene; (b) ethynyl magnesium bromide. These two methods were used on the saturated ester, ethyl 2-methyl-3-oxocyclopentanecarboxylate (VI)

and on the unsaturated ester, methyl 2-methyl-3-oxo-1-cyclopentene-1-carboxylate (IX). None of the expected ethynyl product could be isolated.

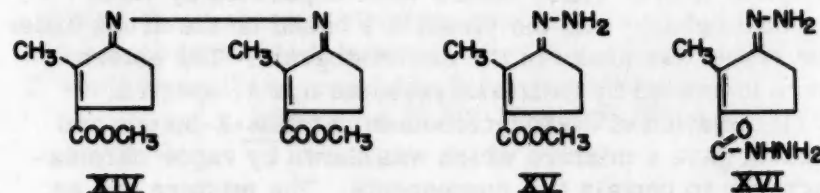
Diels-Alder Reaction

Since all attempts to block satisfactorily the ketone group of methyl 2-methyl-3-oxo-1-cyclopentene-1-carboxylate (IX) by acetal formation or ethynylation failed, Diels-Alder reactions with butadiene, 2-methoxy butadiene, and 2,3-dimethylbutadiene were attempted. Under the wide range of conditions that were used no Diels-Alder adduct between any of the dienes and (IX) was obtained.

Reaction with Hydrazine

Since methyl 2-methyl-3-oxo-1-cyclopentene-1-carboxylate (IX) did not undergo a Diels-Alder reaction with various dienes under the conditions used, it was decided to investigate the reaction of this compound with hydrazine. The extreme ease with which the ester (IX) was saponified suggested that perhaps the hydrazide might be preferentially formed. This compound could then be converted to the azide which on rearrangement by means of the Curtius reaction might yield 2-methyl-1,3-cyclopentanedione. This would offer a new route⁵ to the synthesis of this potentially valuable compound.

The only products that could be isolated from the reaction of methyl 2-methyl-3-oxo-1-cyclopentene-1-carboxylate (IX) with hydrazine were: the hydrazone (XV), the hydrazide-hydrazone (XVI) and the azine (XIV) of the ester (IX). The reaction of methyl 3-methoxy-2-methyl-1,3-cyclopentadiene-1-carboxylate (XI) with hydrazine gave the hydrazide-hydrazone of methyl 2-methyl-3-oxo-1-cyclopentene-1-carboxylate (XVI).



All attempts to prepare the acid chloride of 2-methyl-3-oxo-1-cyclopentene-1-carboxylic acid (VIII) for possible conversion to the azide gave only a polymer.

Part II

Frequently in the synthesis of organic compounds, the worker is faced with the problem of using a reagent with a compound having two functional groups either of which will react with the reagent. One means of reducing the activity of one functional group in the presence of another is to render one functional group less reactive by attaching a group which by its steric hindrance prevents the reaction of the functional group with the reagent. Usually this method is limited to the protection of an alcohol function by a sterically hindering acid group or the protection of an acid group by a sterically hindering alcohol group.

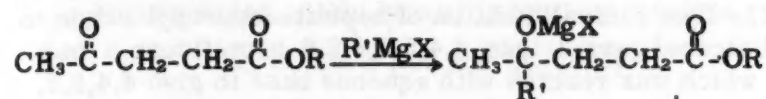
Loening, Garrett, and Newman⁶ have shown that there is a 7000 fold decrease in the rate of esterification of $(\text{CH}_3)_3\text{C}-\text{C}(\text{CH}_3)_2-\text{COOH}$ as compared to acetic acid due mainly to steric hindrance.

The alcohol portion of an ester can likewise show a steric effect and prevent or decrease the addition of a

reagent across the carbonyl oxygen bond. This is illustrated by the 50 fold decrease in the hydrolysis constant of $\text{CH}_3\text{COOCH}_2(\text{CH}_2)_2\text{CH}_3$ compared to $\text{CH}_3\text{COOC}(\text{CH}_3)_3$.^{7,8}

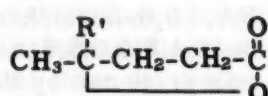
However, there are few examples in the literature on the subject where this method of protecting one of two functional groups from the reaction of a reagent capable of reacting with either functional group has been used. Since no systematic study had been made, it was proposed to study the reaction of various Grignard reagents with primary, secondary, and tertiary alkyl esters of a γ -keto acid such as levulinic acid.

The general reaction of the various esters of levulinic acid with Grignard reagents is as follows:



Where R is methyl, ethyl, isopropyl, isobutyl, diisopropylmethyl, or t-amyl,

R' is methyl, ethyl, or phenyl



HOH
HX

A series of pure normal-esters—methyl, ethyl, isopropyl, isobutyl, diisopropylmethyl, and t-amyl—of levulinic acid were prepared and allowed to react with methyl, ethyl, and phenyl Grignard reagents. The amount of lactone isolated was taken as a measure of the effectiveness of the primary, secondary, or tertiary alcohol group of the ester in preventing a side reaction of the Grignard reagent with the ester group.

The solvent, rate of addition of the Grignard reagent,

Table I
Reaction of Grignard Reagents with Various Esters of Levulinic Acid

Grignard Reagent	Solvent	Starting ester and % yield of lactone from each					
		Methyl	Ethyl	Isopropyl	Isobutyl	Diisopropylmethyl	t-amyl
MeMgBr	Benzene			58.8 (6)	39.9 (2) 39.7 (2a) 50.4 (6) 53.2 (6a)	35.1 (6)	
EtMgBr	Ether	34.8 (2)	37.5 (1)	55.5 (1)	40.9 (1)		42.7 (1)
						39.9 (3)	
	Benzene	46.4 (2)			52.6 (3) 61.9 (4)	53.9 (3)	
		34.2 (5)	38.5 (4) 49.5 (5)	50.0 (4) 44.9 (5)	53.0 (5)	46.9 (5)	61.9 (5)
C ₆ H ₅ MgBr	Ether	26.1 (2)	13.5 (4)	21.7 (4)			
	Benzene	49.4 (2)	8.93 (3) 49.1 (5)	43.2 (5) 39.8 (5)	35.8 (5) 28.8 (5)	37.1 (5) 36.7 (5)	49.8 (5)
		34.5 (5)					

Difficulty of separating lactone made results here inaccurate.

Conditions

- (1) Work up product 15 min. after addition of Grignard reagent (no heat used).
- (2) Work up product 60 min. after addition of Grignard reagent (no heat used).
- (2a) Work up product 2 hr. after addition of Grignard reagent (no heat used).
- (3) Reflux 30 min. before decomp. Grignard complex and reflux 45 min. after decomp.
- (4) Work up product 2.5 hr. after addn. of Grignard reagent and after decomp. of Grignard complex heat 45 min.
- (5) Work up product 2.5 hr. after addn. of Grignard reagent and reflux 30 min. before work up. (These conditions were believed to be the best).
- (6) Work up product after setting overnight in refrigerator (no heat used).
- (6a) Here the Grignard reagent was added in 1 min. instead of the customary 60 min., and the material was worked up in 1 hour (no heat used).

and the effect of time and temperature on the work-up of the Grignard addition product were shown to affect the yield considerably and in many instances varied with different esters. (See conditions 1 to 5, table I). Condition 5 was considered to be the best for comparing the reactivity of the Grignard reagents with esters of levulinic acid. The results of the study of the best conditions for reacting different Grignard reagents with various esters of levulinic acid showed that it was very difficult to find one set of experimental conditions which would apply equally well for the reactions of all of the esters of levulinic acid with a particular Grignard Reagent.

The substituted lactone resulting from the reaction of the Grignard reagents with the keto group of each ester was determined, and the yields showed that the tertiary alkyl ester was the most effective in sterically hindering the side reaction of the Grignard reagent with the ester group.

There was found to be very little difference in the effect of a primary or a secondary alkyl-ester. However, within the primary alkyl esters, there is an advantage in using the ethyl ester over the methyl ester to hinder sterically the reaction of the ester group with the Grignard reagent.

Microfilm \$2.00; Xerox \$5.00. 96 pages. —

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I. A NEW APPROACH TO THE
ISOQUINOLINE SYSTEM.
II. STUDIES ON HAPLOPHYTINE.

(L. C. Card No. Mic 59-2043)

Robert Arthur Mooney, Ph.D.
University of Illinois, 1959

I

The condensation of *o*-xylylene dibromide with suitably substituted amides to give 1,2,3,4-tetrahydroisoquinolines was investigated. A fair yield (43%) of 2-acetyl-3,3-dicarbomethoxy-1,2,3,4-tetrahydroisoquinoline was obtained when *o*-xylylene dibromide was treated with ethyl acetamidomalonate and sodium methoxide in refluxing methanol. A second product, 1,2-bis-(β , β -dicarbomethoxy- β -acetamido)-ethylbenzene was also obtained.

An 83 per cent yield of 2-formyl-3,3-dicarbomethoxy-1,2,3,4-tetrahydroisoquinoline was obtained from the base induced reaction of *o*-xylylene dibromide with ethyl formamidomalonate in methanol. It was found more convenient to convert the tetrahydroisoquinoline derivative to its hydrobromide salt by refluxing in methanolic hydrobromic acid. No evidence for the formation of a dialkylated *o*-xylene was found.

No tetrahydroisoquinoline was obtained from the reaction between *o*-xylylene dibromide and ethyl α -acetamidoacetoacetate. The product from the reaction run in methanol was 1,2-bis-(β -carbomethoxy- β -acetamido)-ethylbenzene.

The results obtained from the reactions employing amidomalonate esters suggest the practicability of the method as a synthetic tool. The products may be useful intermediates in natural product syntheses.

II

Further structural studies on haplophytine, the main alkaloid of *Haplophyton cimicidum*, were carried out. On the basis of the identification of γ -aminobutyric acid as one of the products of the prolonged chromic acid oxidation of haplophytine, it was determined that the alkaloid contains a trimethylene link attached to a nitrogen atom. The amino acid was identified by paper chromatographic techniques. Similarly, the product obtained upon permanganate oxidation of haplophytine was also shown to contain the trimethylene chain attached to a nitrogen atom; on the other hand, the peroxide oxidation product does not.

An improved preparation of *O*-methylhaplophytine was developed. The previous method, methylation with diazomethane, was lengthy. Methylation with phenyltrimethylammonium ethoxide produced the methyl ether in 62 per cent yield; unreacted haplophytine could be recovered. It was believed that reactions run on the methyl ether would prove more fruitful than those which had been run on the parent alkaloid, since most of the products had not been obtained in pure or crystalline form.

The reaction of cyanogen bromide with *O*-methylhaplophytine produced an amorphous material which could not be characterized. Similar results were obtained upon ethanolysis of the ether with sodium ethoxide in boiling ethanol. Attempts to prepare a pure methiodide of the methyl ether failed. Lithium aluminum hydride reduction of *O*-methylhaplophytine led to an amorphous product which, however, exhibited no carbonyl peaks in its infrared spectrum.

Microfilm \$2.00; Xerox \$3.80. 69 pages.

THE PREPARATION OF SOME
FLUORINE-CONTAINING MONOMERS

(L. C. Card No. Mic 59-1633)

Leslie David Moore, Ph.D.
Purdue University, 1959

Major Professor: E. T. McBee

The synthesis of difunctional compounds containing highly fluorinated portions of the molecule as part of the central chain and other highly fluorinated monomers was the object of this investigation.

The free radical addition of heptafluoropropyl iodide to allyl alcohol gave 2-iodo-4,4,5,5,6,6,6-heptafluoro-1-hexanol which was reacted with aqueous base to give 4,4,5,5,6,6,6-heptafluoro-1,2-epoxyhexane. This epoxide was hydrolyzed to give 4,4,5,5,6,6,6-heptafluoro-1,2-hexanediol. Reduction of 2-iodo-4,4,5,5,6,6,6-heptafluoro-1-hexanol gave 4,4,5,5,6,6,6-heptafluoro-1-hexanol which was oxidized to give 4,4,5,5,6,6,6-heptafluorohexanoic acid and dehydrated to give 4,4,5,5,6,6,6-heptafluoro-1-hexene. This olefin also was prepared by the dehalogenation of 1-chloro-2-iodo-4,4,5,5,6,6,6-heptafluorohexane which was prepared by the addition of heptafluoropropyl iodide to allyl chloride. Attempts to oxidize this olefin to 3,3,4,4,5,5,5-heptafluoropentanoic acid were not successful.

The addition of 1,3-diiodohexafluoropropane to allyl alcohol gave 2,8-diiodo-4,4,5,5,6,6-hexafluoro-1,9-nonanediol which was reduced to give 4,4,5,5,6,6-hexafluoro-1,9-nonanediol. Oxidation of this glycol gave 4,4,5,5,6,6-hexafluoroazelaic acid. Compounds derived from this acid were the corresponding acid chloride and diethyl ester.

The addition of 1,3-diiodohexafluoropropane to allyl chloride gave 1,9-dichloro-2,8-diiodo-4,4,5,5,6,6-hexafluorononane which was dehalogenated to give 4,4,5,5,6,6-hexafluoro-1,8-nonadiene. Attempts to oxidize this olefin to 3,3,4,4,5,5-hexafluoropimelic acid were not successful.

Perfluoroglutaryl chloride was prepared by the action of oxalyl chloride on perfluoroglutaric anhydride. An attempted Arndt-Eistert reaction on this acid chloride was not successful. Microfilm \$2.00; Xerox \$5.00. 98 pages.

THE SYNTHESIS OF ANALOGS OF THE
PYRIMIDINE MOIETY OF THIAMINE

(L. C. Card No. Mic 59-1986)

John Graham Nairn, Ph.D.
The University of Buffalo, 1959

A study of some of the chemistry of 4-amino-2-methylthio-5-pyrimidinemethanol, an interesting antimetabolite and anti-tumor agent, has been described. This included the following types of reactions: esterification, oxidation, substitution, cyclization, and amide formation.

The action of chlorine and water on several 2-methylthiopyrimidines not only led to the preparation of 2-methylsulfonylpyrimidines, but also led to the preparation of partially saturated pyrimidines.

It was shown that the methylsulfonyl group on the 2-position of the pyrimidine ring was more easily replaced by nucleophilic reagents, such as amines, than was the methylthio group on the same position.

Experiments with 4-amino-2-methylthio-5-pyrimidine-carbonitrile showed that this compound was difficult to reduce to the 5-aminomethylpyrimidine and the 5-carboxamide derivative could be prepared by hydrolysis. When the 5-pyrimidinecarboxamide was allowed to react with triethylorthoformate and acetic anhydride, a substituted pyrimido(4,5-d)pyrimidine was formed.

Microfilm \$2.00; Xerox \$3.80. 70 pages.

THE SYNTHESIS OF SOME PYRIMIDINES OF POTENTIAL ANTI-NEOPLASTIC ACTIVITY

(L. C. Card No. Mic 59-1987)

Earl Peters, Ph.D.
The University of Buffalo, 1959

Two esters, ethyl gamma,gamma-diethoxy-alpha-ethoxymethyleneacetoacetate and methyl gamma,gamma-dimethoxy-alpha-methoxymethyleneacetoacetate, were synthesized with a view to utilizing them as precursors in the synthesis of some pyrimidines of potential biological interest. The yield of solid material isolated in several attempts at condensation of ethyl gamma,gamma-diethoxy-alpha-ethoxymethyleneacetoacetate with acetamidine or 2-methyl-2-thiopseudourea was so low, that at present this cannot be considered a satisfactory route towards the desired pyrimidines.

An improved method for the preparation of 2-benzylthio- and 2-methylthio-4-chloro-5-carbethoxypyrimidine, by treatment of the sodium salt of the corresponding 4-hydroxypyrimidine with phosphorus oxychloride, is reported.

Several 2-methyl-, 2-methylthio- and 2-benzylthio-4-(substituted-amino)-5-carbethoxypyrimidines were prepared by treatment of the corresponding 4-chloropyrimidine with alkyl- or arylamines. Some of the compounds were found, by others, to inhibit the growth of a spectrum of mouse tumors.

Several of the 5-carbethoxypyrimidines were converted to their 5-hydroxymethyl analogs by means of lithium aluminum hydride. The tumor-inhibiting properties of the compounds were not enhanced thereby.

Treatment of 2-methylthio-4-chloro-5-carbethoxypyrimidine with phenol and thiophenol gave, respectively, the corresponding 4-phenoxy- and 4-phenylthiopyrimidine.

The reaction between 2-methylthio-4-chloro-5-carbethoxypyrimidine with phenylhydrazine did not give the expected 4-phenylhydrazinopyrimidine. Instead a pyrazolo-(3,4-d)pyrimidine was formed. This reaction represents a new route to compounds of this type, which are also of biological interest.

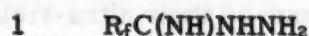
Microfilm \$2.00; Xerox \$5.20. 104 pages.

REACTIONS OF HYDRAZINE WITH SOME FLUOROCARBON DERIVATIVES

(L. C. Card No. Mic 59-1728)

Donald Pilipovich, Ph.D.
The University of Florida, 1959

The chemistry of the perfluoroalkane nitriles has been extended to include the study of their reactions with hydrazine. A new class of compounds has resulted from this study in that the free, unsubstituted perfluoroalkane hydrazidines were prepared. The perfluoroalkane hydrazidine is represented by structure 1:



Specific compounds were prepared where R_f - was present as C_3F_7 , C_4F_9 , C_5F_{11} and C_7F_{15} . Two perfluoroalkane dinitriles were also reacted with hydrazine to form the , -perfluoroalkane dihydrazidine. The physical and chemical properties of the perfluoroalkane hydrazidines are discussed.

In addition to the perfluoroalkane hydrazidines, the perfluoronitriles also yield bis(perfluoroalkyl)-1,N-amino-1,3,4- triazoles. Two compounds are reported with the structure, bis(trifluoromethyl)- and bis(pentafluoropropyl)-1,3,4- N-amino triazoles. The postulated route of formation of the organic triazoles was shown not to be applicable to the formation of the perfluoroalkyl N-aminotriazoles.

A compound believed to be bis(heptafluoropropyl)-1,2-diazetidine was prepared from the reaction of phosphorous pentachloride on bis(heptafluorobutyl) hydrazine. The preparation of several mono- and di- perfluoroacyl hydrazines is given. Microfilm \$2.00; Xerox \$4.00. 75 pages.

SYNTHESIS OF SOME NEW CHALCONES AND 3-HYDROXY CHROMONES

(L. C. Card No. Mic 59-2075)

Kamalakar Balkrishna Raut, Ph.D.
The University of Oklahoma, 1959

Major Professor: Dr. Simon H. Wender

Previous workers have investigated many flavonoid compounds for biological activity in animals. In the present investigation, some new chalcones and 3-hydroxy chromones have been synthesized with a heterocyclic or a polycyclic ring, attached to the number two carbon of the γ -benzopyrone. These new compounds are to be compared for their biological activity with previously known flavonoid compounds.

The 3-hydroxy chromones were synthesized by preparing the corresponding 2-hydroxy chalcones and oxidizing the chalcones with alkaline hydrogen peroxide by the Algar-Flynn method. In a few cases, 3-hydroxy chromones were prepared in one step by the Ranjorwa reaction. The starting materials were 2-hydroxy acetophenone and the aldehyde of the corresponding polycyclic or heterocyclic compound. In one case, 2-hydroxy 5-methyl acetophenone was used in place of the 2-hydroxy acetophenone. Using these methods the following 3-hydroxy chromones were obtained.

1. 2-(9-anthracyl) 3-hydroxy chromone
2. 2-(9-anthracyl) 3-hydroxy 6-methyl chromone
3. 2-(9-phenanthryl) 3-hydroxy chromone
4. 2-(1-naphthyl) 3-hydroxy chromone
5. 2-(2-naphthyl) 3-hydroxy chromone
6. 2-(2-thienyl) 3-hydroxy chromone
7. 2-(2-pyridyl) 3-hydroxy chromone
8. 2-(3-pyridyl) 3-hydroxy chromone
9. 2-(2-pyridyl 6 methyl) 3-hydroxy chromone
10. 2-(2-quinonyl) 3-hydroxy chromone

The corresponding hydroxy chalcones and acetates of each 3-hydroxy chromone were synthesized. Properties of these compounds such as their ultra-violet spectra, infrared spectra, color reactions and melting points have also been studied. Microfilm \$2.00; Xerox \$4.00. 75 pages.

CERTAIN ASPECTS OF THE CHEMISTRY OF METHYL VINYL KETONE

(L. C. Card No. Mic 59-2406)

Norman C. Ross, Ph.D.
University of Pittsburgh, 1959

The reactions of methyl vinyl ketone with a variety of active hydrogen compounds have been studied using several bases as condensing agents. Under appropriate reaction conditions, the Michael Condensation occurs between methyl vinyl ketone and ketones, esters, amines, tar bases, and nucleophilic inorganic salts.

With the exception of acetone, acetophenone, cyclopentanone, and phenacylpyrazine, the initially formed Michael adducts of ketones to methyl vinyl ketone undergo intramolecular aldol condensation. Thus, the product of most ketone-methyl vinyl ketone reactions is a cyclohexanone derivative.

Acetone, acetophenone, propiophenone, n-butyrophenone, cyclopentanone, and methyl n-propyl ketone give the highest yield of products when their lithium derivatives are treated with methyl vinyl ketone. On the other hand, cyclohexanone, 2-methylcyclohexanone and methyl benzyl ketone reacted equally as well with methyl vinyl ketone either as their lithium derivatives or in the presence of catalytic amounts of the bases, potassium hydroxide or benzyltrimethylammonium hydroxide.

In the case of the methyl benzyl ketone-methyl vinyl ketone adduct, (condensation occurs on the α -methylene carbon) cyclization can occur in two ways. Thus, it is possible that two intramolecular aldol products and their dehydrated derivatives could be formed. Three of these products have been isolated and identified. These are 3-methyl-3-hydroxy-4-phenylcyclohexanone, 3-methyl-4-phenylcyclohex-2-enone and 3-methyl-6-phenylcyclohex-2-enone.

The highly reactive ketones, phenacylpyrazine, 2-phenacylpyridine, desoxybenzoin and acetylacetone, reacted with methyl vinyl ketone to give high yields of adducts in the presence of catalytic amounts of base. Both 2-phenacylpyridine and desoxybenzoin gave mixtures of the normal and cyclized products while phenacylpyrazine and acetylacetone gave only the normal addition products.

Although ethyl acetate did not add to methyl vinyl ketone,

ethyl phenylacetate reacted both as its lithium derivative and in the presence of catalytic amounts of potassium t-butoxide to give ethyl 2-phenyl-5-ketohexanoate.

Ethyl acetoacetate, ethyl benzoylacetate and diethyl malonate also added to methyl vinyl ketone in the presence of catalytic amounts of potassium hydroxide and benzyltrimethylammonium hydroxide to give high yields of mono-addition products.

Primary amines add to methyl vinyl ketone in the absence of additional base to give high yields of the expected Michael adducts. However, with the exception of the methyl vinyl ketone-aniline adduct, the primary amine adducts from n-propylamine, cyclohexylamine and t-butylamine could not be isolated and purified in the free state. These adducts were isolated as their hydrochlorides or oxalates.

The secondary amines, diethylamine and morpholine, also reacted with methyl vinyl ketone in the absence of additional base to give high yields of the corresponding Mannich bases.

The tar bases α -picoline and γ -picoline both reacted with methyl vinyl ketone either as their sodium derivatives or their lithium derivatives. Although γ -picoline reacted normally to give the expected ketone, 5-(4-pyridyl)-2-pentanone, α -picoline added across the carbonyl group of methyl vinyl ketone to give the tertiary alcohol, 3-(2-picolyl)-3-hydroxy-1-butene.

Methyl vinyl ketone reacted with sodium sulfide to give a mixture of 4-mercapto-2-butanone and di(3-ketobutyl)sulfide in the absence of additional base.

In the presence of acetic acid, methyl vinyl ketone reacted with potassium cyanide to give 3-ketobutyl cyanide.

Microfilm \$2.00; Xerox \$5.80. 120 pages.

UTILIZATION OF CINCHONINIC ACIDS IN THE SYNTHESIS OF QUINOLINEMETHANOLS

(L. C. Card No. Mic 59-2508)

Isaac Joseph Satterfield, Ph.D.
The University of Texas, 1958

Supervisor: Dr. H. R. Henze

Under the usual Pfitzinger conditions, the condensation of alkyl methyl ketones and isatin resulted in the synthesis of nine alkylated cinchoninic acids. The existing data for the latter have been corroborated and in several cases expanded. A series of ethyl alkylquinoline-4-carboxylic esters was prepared from the corresponding cinchoninic acids; four of these esters had not been previously reported.

The lithium aluminum hydride reduction of the cinchoninic ester, and of the precursor cinchoninic acid in some cases, was utilized in the synthesis of nine alkylated 4-quinolinemethanols. Only one compound of the series had been previously synthesized. Results of an investigation of the relative merits of direct reduction of the carboxylic acid to the corresponding primary alcohol, as compared with the esterification of the acid and subsequent reduction of the ester to the primary alcohol, strongly suggest that the latter method should be the one of choice. The reduction of alkylquinoline-4-carboxylic esters by lithium aluminum hydride was found to be a satisfactory method of synthesis of alkylated 4-quinolinemethanols.

Reduction of the 4-quinolinecarbinols with hydriodic acid and red phosphorus yielded the corresponding alkylated lepidines, isolated either as the hydroiodide or as the free base. Thus, this reduction procedure offered a method of synthesis of 4-methylquinolines having alkylation in the heterocyclic nucleus. Of significance is the general applicability of this method to the preparation of homologous and/or analogous lepidines containing a substituent on the heterocyclic ring.

Microfilm \$2.00; Xerox \$5.60. 112 pages.

CATALYSIS IN THE AMINOLYSIS OF METHYL ACETATE. THE EFFECTS OF SOLVENT, SALT AND REACTANT CONCENTRATIONS ON THE KINETICS.

(L. C. Card No. Mic 59-2267)

Sheldon Irwin Schlesinger, Ph.D.
University of Pennsylvania, 1959

Supervisors: Allan R. Day and John G. Miller

A kinetic study was undertaken to gain more insight into the catalytic effect of solvents and salts on the aminolysis of methyl acetate. The reactions were run at 30°, and were followed by acid-base titration to determine the amine concentration.

Methyl acetate was reacted with *n*-butylamine in the presence of initial methanol concentrations ranging from 0.-14 M, and methanol diluent. In all but the latter case, benzene was used as the diluting solvent. It was found that the rate constants increase with increasing initial methanol concentrations. In methanol the kinetic order varied with the relative concentrations of amine and ester. Second order kinetics was followed when the initial amine: ester ratio was 2M.: 0.5M., 2M.: 1M., or 2M.: 2M. But with ratios of 0.5M.: 2M. or 1M.: 2M., the reactions followed the third order equation, $\frac{dx}{dt} = (\text{amine})^2(\text{ester})$. When no

methanol was added the aminolyses followed second order kinetics in every case. A similar change in kinetic order was observed in the methanol catalyzed reaction of piperidine with methyl acetate.

It was found that this change in kinetic order also occurs when methanol-benzene solvent mixture are replaced by the solvents *n*-butanol-benzene or methanol-dioxane. However, with *t*-butanol-benzene as the solvent mixture, only second order kinetics was observed in the cases studied. Triethylamine did not have an appreciable catalytic effect on the reaction of *n*-butylamine with methyl acetate, but its presence did affect the kinetic order with ester as excess reactant.

The salts lithium bromide, tetraethylammonium bromide, and *n*-butylamine hydrobromide were found to have catalytic effects on aminolysis in the order mentioned. The *n*-butylamine hydrobromide had a very small effect and retarded the reaction in one case.

The enthalpies and entropies of activation were determined for second and third order reactions in 8M. and 14M. methanol. The higher methanol concentration gave the smaller enthalpy of activation, while the entropy of activation was the same in both concentrations. It was

also found that the enthalpies of activation for the second order reactions are greater than for third order. The entropy of activation is less negative for the second order reactions.

A mechanism is postulated involving the control of the kinetics by two complexes formed by interaction of the reactants with alcohol. The one which predominates in excess amine consists of one amine molecule and one ester molecule in the activated complex, while in excess ester the activated complex involves two amine molecules and one ester molecule. In both cases alcohol participates in the activated complex by hydrogen-bonding to the reactants.

Microfilm \$2.00; Xerox \$4.00. 71 pages.

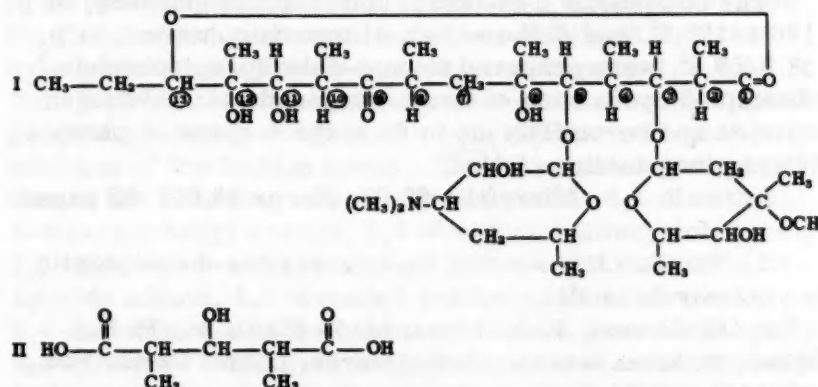
I. STEREOCHEMISTRY OF DEGRADATION PRODUCTS OF ILOTYCIN AND II. AN ATTEMPTED SYNTHESIS OF TETRAHYDROQUINOLINES

(L. C. Card No. Mic 59-2268)

Walter Arthur Schroeder, Ph.D.
University of Pennsylvania, 1959

Supervisor: Charles C. Price

An attempt was made to confirm the stereochemical configuration proposed by workers at the E. Lilly Laboratories for the C-7 diacid degradative fraction (II) of the erythromycin molecule¹ (I). They found the diacid (II), rep-



resenting carbon atoms one through five of the erythromycin molecule, to be *meso* in character.²

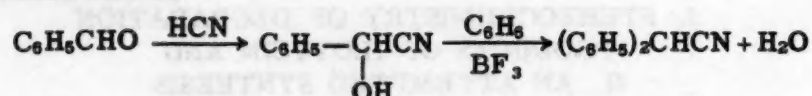
Several methods were employed in an attempt to synthesize the diacid (II). The condensation of two moles of ethyl α -bromopropionate with one mole of ethyl formate via the Reformatsky reaction,³ was the only method which yielded the desired product. The diester of the diacid (II) was obtained from this reaction in 10-20% yields. The fractional distillation and vapor phase chromatograph of this diester, ethyl α, α' -dimethyl- β -hydroxyglutarate, b. p. 100.4° (1.0 mm.), n_D^{30} 1.4367, D_4^{30} 1.0538, indicated that primarily one isomer was obtained. To confirm this fact, several solid derivatives were prepared. The simple dihydrazide, di-(2,4-dinitrophenylhydrazide), and di-(*p,p'*-phenylazobenzo-ylhydrazide) were amorphous in character. The di-(*n*-decanoylhydrazide) derivative proved to be more crystalline in nature. The X-ray spectral analysis of samples of this fractionally crystallized compound indicated conclusively that primarily one isomeric form was obtained. This product could be the racemate or one of the *meso* forms.

Fractional crystallization of the d-10-camphorsulfonic acid salt of α, α' -dimethyl- β -hydroxyglutaryl dihydrazide and isolation of the dihydrazide as the n-decanoyl derivative failed to afford optically active material.

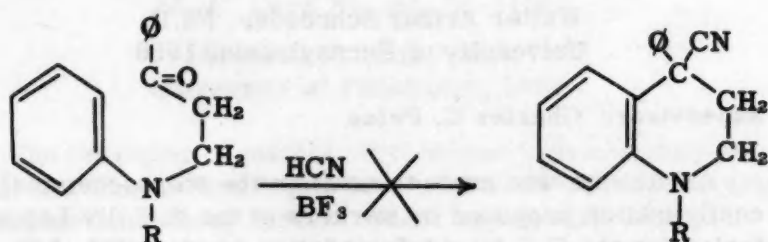
It was concluded that a *meso* isomer of ethyl α, α' -dimethyl- β -hydroxyglutarate was obtained from the Reformatsky reaction. Since for the unequivocal determination of the stereochemistry of the C-7 diacid degradation fragment of Ilotycin, we had hoped to have as starting materials the *d*, *l*, and both *meso* forms, further efforts to pursue this approach to the problem were considered impractical.

Several derivatives of β -anilinopropiophenone were prepared to determine if the scope of the Mills reaction⁴ could be broadened to include cyclization of these compounds to substituted tetrahydroquinolines.

Mills Reaction:



Proposed Cyclization:



The compounds β -N-benzoylanilinopropiophenone, m. p. 136.1-136.6°, and β -N-methylanilinopropiophenone, m. p. 58.9-59.5°, were prepared from β -chloropropiophenone.⁵ Attempted cyclization of these compounds with hydrogen cyanide and boron fluoride to form the 4-cyano-4-phenyl-tetrahydroquinolines failed.

Microfilm \$2.00; Xerox \$3.60. 65 pages.

1. The E. Lilly and Co. trade-mark for the antibiotic erythromycin is Ilotycin.
2. K. Gerzon, E. H. Flynn, M. V. Sigal, Jr., P. F. Wiley, R. Monahan, and U. C. Quarck, J. Am. Chem. Soc., **78**, 6396 (1956).
3. S. Reformatsky, Ber., **28**, 3263 (1895).
4. J. Mills, E. Lilly and Co., U. S. Patent 2,447,419 (1948).
5. M. A. Collet, Bulletin de la Societe Chimique de France, [3], **17**, 80 (1897).

THE NON-CATALYTIC HALOGENATION OF TOLUENE, t-BUTYLBENZENE, ANISOLE AND BIPHENYL

(L. C. Card No. Mic 59-1647)

Leon Milo Stock, Ph.D.
Purdue University, 1959

Major Professor: Herbert C. Brown

The proposal that the electrophilic substitution reactions of monosubstituted benzenes adhered to a simple linear relationship of the Hammett type was subjected to test by an examination of the non-catalytic halogenation reactions of toluene, t-butylbenzene, anisole and biphenyl.

The isomer distribution in the non-catalytic bromination of toluene in 85% acetic acid at 25° was established as 32.9% *o*-, 0.3% *m*- and 66.8% *p*-bromotoluene by infrared spectroscopy. The relative rate of bromination of toluene with respect to benzene under these conditions was determined to be 605/1.00. These data provide the partial rate factors ρ_f 600, ρ_m 5.5 and ρ_p 2420. The partial rate factors were employed to calculate the relative rates of bromination of the polymethylbenzenes. Experimental determination of these relative rates indicated good agreement, 28%, with the calculated values.

The isomer distribution in the non-catalytic chlorination of toluene in 99.87% acetic acid at 25° was analyzed by infrared spectroscopy to be 59.78% *o*-, 0.48% *m*- and 39.74% *p*-chlorotoluene. The second order rate constants were determined for the chlorination of benzene, toluene, *o*-, *m*- and *p*-xylene. The relative rate of chlorination of toluene and benzene, 344, and the isomer distribution provide the partial rate factors ρ_f 617, ρ_m 4.95 and ρ_p 820. The rates for the xylenes were in good agreement, 10%, with the values calculated on the basis of the partial rate factors. The isomer distribution for *m*-xylene was determined to be 23% 2- and 77.0% and 77.0% 4-chloro-1,3-dimethylbenzene.

The relative rate of the aluminum chloride-catalyzed acetylation in ethylene dichloride at 25° of toluene to benzene was determined by competitive procedures to be 128/1.00. The isomer distribution established by vapor phase chromatography was 1.17% *o*-, 1.26% *m*- and 97.7% *p*-methylacetophenone. These data allow the calculation of the partial rate factors ρ_f 4.5, ρ_m 4.8 and ρ_p 746. The acetylation reaction was examined kinetically and found to be similar in all respects to the benzylation reaction. However, the acetylation is some 500 fold more rapid.

The three reactions described above adhere to the Selectivity Relationship for toluene. The available data for 47 electrophilic substitution reactions of toluene were examined statistically. The analysis revealed that an average error of only 7.68% was developed in the reaction constant, ρ . The average per cent error in ρ for 24 selected Hammett side-chain reactions of *m*- and *p*-tolyl derivatives is 18.5%. The minor derivatives from the Selectivity Relationship are attributed to certain experimental difficulties and the influence of pi-complexes on reactivity.

The non-catalytic bromination of t-butylbenzene in 85% acetic acid at 25° yielded 1.20% *o*-, 1.47% *m*- and 97.3% *p*-bromo-t-butylbenzene. The relative rate, t-butylbenzene to benzene, was determined to be 138/1.00. The partial rate factors are then ρ_f 4.97, ρ_m 6.1 and ρ_p 806. The

chlorination reaction in 99.89% acetic acid provided 21.5% *o*-, 2.29% *m*- and 76.2% *p*-chloro-*t*-butylbenzene. The rates of halogenation of certain *p*-alkyl-*t*-butylbenzenes were examined. The chlorination of *p*-di-*t*-butylbenzene yielded 71.4% 2-chloro-1,4-di-*t*-butylbenzene and 28.6% *p*-chloro-*t*-butylbenzene. Similarly, the chlorination of *p*-*t*-butyltoluene led to the formation of 5.0% *p*-chlorotoluene and 95% substitution. These data permit the evaluation of the true substitution rates. The rates so established are in good agreement with the values calculated on the basis of the partial rate factors.

The bromination of anisole in acetic acid at 25° was shown to produce 2.3% *o*- and 97.7% *p*-bromoanisole. The relative rate of bromination was determined to be $1.79 \times 10^9/1.00$. These data provide the partial rate factors, ρ_f 1.2×10^8 and ρ_f 1.1×10^{10} . The relative rates of bromination of *p*-substituted anisoles were found to be in the order *p*-*t*-butyl, 1.10×10^8 ; *p*-methyl, 9.30×10^7 ; *p*-phenyl, 5.06×10^6 and *p*-methoxy, 1.52×10^8 . These results were utilized to provide estimates for ρ_f : *t*-butyl, 6.5; phenyl, 0.30 and methoxy, 1.7.

The bromination of biphenyl in 85% acetic acid at 25° produced 2.5% *o*- and 97.5% *p*-bromobiphenyl. The kinetic relative rate, biphenyl to benzene, was determined to be 508/1.00. The partial rate factors are established as ρ_f 38.3 and ρ_f 2970.

For each molecule the available data for electrophilic substitution were examined. The reactions of *t*-butylbenzene and anisole adhere to a simple linear relationship. The average per cent error in the reaction constant, ρ , is 8.82% for the *t*-butyl group and 11.5% for methoxy. The substitution reactions of biphenyl fail correlation. This failure is attributed to the steric interference of the four *o*-hydrogens to the achievement of full coplanarity of the phenyl nuclei.

The data obtained in this study and earlier investigations for the bromination and chlorination reactions are satisfactorily correlated by σ^+ constants developed for aromatic substitution.

Microfilm \$4.90; Xerox \$16.40. 384 pages.

PART I: STUDIES CONCERNED WITH THE MECHANISM OF LITHIUM-ALKYLAMINE REDUCTIONS OF AROMATIC RINGS.

PART II: THE ELECTRICAL INFLUENCE OF THE TRICHLOROSILYL GROUP.

PART III: THEORETICAL ASPECTS OF SILACYCLIC COMPOUNDS.

(L. C. Card No. Mic 59-1648)

Donald George Stoffey, Ph.D.
Purdue University, 1959

Major Professor: R. A. Benkeser

PART I. STUDIES CONCERNED WITH THE MECHANISM OF LITHIUM-ALKYLAMINE REDUCTION OF AROMATIC RINGS

Reduction of cumene with lithium in methylamine yields a mixture of the three possible monoolefins as shown by infrared analysis. Oxidation of the reduction product by

performic acid gives all three possible *trans* glycols, the properties of which are given. Reduction of toluene under the same conditions also gives a mixture of monoolefins as demonstrated by infrared analysis. The monoolefins resulting from the reductions are shown to be stable toward isomerization under the strongly basic conditions of the reductions. The disproportionation of 2,5-dihydrotoluene into toluene and methylcyclohexenes under the conditions of the reduction is shown to be much slower than the reduction itself. A mechanism for the lithium-alkylamine reductions is offered.

PART II. THE ELECTRICAL INFLUENCE OF THE TRICHLOROSILYL GROUP

The isomer distribution for the ionic chlorination of phenyltrichlorosilane is given. The isomer distribution for the ionic brominations of phenyltrichlorosilane, benzo-trichloride and methylbenzoate are also given. The electrical influence of these groups are compared with other *meta* directors. Evidence is offered for the possibility of π - d orbital overlaps in the resonance hybrid of the trichlorosilyl group. The electrical influence of the trichlorosilyl group seems to be sensitive to its environment.

PART III. THEORETICAL ASPECTS OF SILACYCLIC COMPOUNDS

A silacyclic olefin, 4,4-dimethyl 4-silacyclohexene, was dehydrogenated by means of palladium-charcoal to give 5,5-dimethyl 5-silacyclohexa 1,3-diene. The maleic anhydride of the diene was prepared. The β effect is shown to be operative in silacyclic bromides. It was shown that the Dieckmann condensation can be preformed on tetraalkylsilyldiesters. The Beckmann rearrangement of 4,4-dimethyl 4-silacyclohexanone oxime gives an unidentifiable product, probably because of a β effect on the part of the nitrogen of the lactam group. The preparation and properties of the following new silane are given: 4,4-dimethyl 4-silacyclohexyl acetate, 4,4-dimethyl 4-silacyclohexene, 5,5-dimethyl 5-silacyclohexa 1,3-diene and its maleic anhydride adduct, 4,4-dimethyl 4-silacyclohexyl bromide, 4,4-dimethyl 4-silacyclohexanone oxime, 2-carbethoxyethyl 4,4-dimethyl 4-silacyclohexanone and its 2,4-dinitrophenylhydrazones, dimethyldi-(2-carbethoxyethyl)-silane, dimethyl 4-pentenylchlorosilane and its 9-fluorenyl and 9-phenyl 9-fluorenyl derivatives, and dimethyl 4-pentenylbromosilane.

Microfilm \$2.00; Xerox \$6.80. 144 pages.

REARRANGEMENT STUDIES IN THE NORBORNANE SYSTEM

(L. C. Card No. Mic 59-1868)

Shigeto Suzuki, Ph.D.
University of Southern California, 1959

Chairman: Professor Jerome A. Berson

In order to study the possibility of 2,3-hydride shift in reactions of the bicyclo-(2.2.1)-heptane system, the optically active *exo*-4-hydroxy-*exo*-*cis*-3,6-endomethylene-hexahydrophthalic acid (I) was selected for the purpose on

the grounds that any 2,3-hydride shift that might occur during reactions of I and its derivatives involving carbonium ion-type intermediates would be detectable by partial racemization of the products.

Several different approaches for the stereospecific synthesis of I were attempted. The successful synthesis of I was finally achieved by treating the *exo*-epoxyanhydride of I with hydrogen bromide followed by debromination of the crude product with Raney nickel in boiling water. The hydroxyacid I thus obtained was shown to be identical with the hydroxyacid prepared by Alder by hydration of *exo-cis*-3,6-endomethylele- Δ^4 -tetrahydrophthalic anhydride. The extensive efforts to resolve I and its derivatives were uniformly unsuccessful.

Several epoxides in the bicyclic system were prepared and their chemical behaviors studied. They were found to be unusually stable toward external nucleophilic displacement but not toward internal displacement.

To provide information on whether a migrating alkyl group in a 1,2-rearrangement departs appreciably from tetrahedral geometry under favorable conditions, the Baeyer-Villiger rearrangement of *exo*-acetylnorbornane was studied. With optically active ketone, flattening of the migrating C.2 orbital and delocalization of C.1-C.6 bond electrons might lead to partially or completely racemized product, *exo*-norbornyl acetate.

Partially optically active (-)-*exo*-acetylnorbornane was prepared by the sequence, (-)-*exo*-norbornanecarboxylic acid \rightarrow acid chloride \rightarrow (-)-ketone. The optical purity of the (-)-ketone is known, since the maximum optical rotation of the starting active acid is established by Berson and Ben-Efraim and optical fractionation was avoided during the conversion steps.

The optical rotation of enantiomerically pure *exo*-norbornyl acid phthalate was established by analysis of a partially resolved sample for enantiomer content by isotope dilution with *exo*-norbornyl acid phthalate-carbonyl- C^{14} . Combination of this result with data of Winstein and Trifan afforded rotations of enantiomerically pure *exo*-norborneol and *exo*-norbornyl acetate.

Perbenzoic acid oxidation of the active ketone in chloroform gave *exo*-norbornyl acetate with 94.2-100 per cent retention of optical purity, indicating less than 2.9 per cent attack at C.1.

The possible geometry of relative positions of participating atoms during the course of the reaction was calculated, using a simple model, and the implications of the calculated and experimental results for an understanding of the type of hybridization in the transition state of 1,2-rearrangements were discussed.

Microfilm \$2.05; Xerox \$7.20. 155 pages.

SOME REACTIONS OF NON-ACTIVATED ARYL SULFONES WITH BASES AND NUCLEOPHILIC AGENTS

(L. C. Card No. Mic 59-1650)

Arthur James Tiffan, Ph.D.
Purdue University, 1959

Major Professor: William E. Truce

Sulfones are ordinarily resistant towards attack by bases and nucleophilic agents unless activated by other groups such as the nitro group or subjected to extremely strong bases and high temperatures. This study is concerned with an investigation of the nature of several reactions of non-activated aryl sulfones with bases and nucleophilic agents.

Phenyl sulfone was hydrolyzed by strong aqueous potassium hydroxide at 200° giving phenol, benzene, and potassium sulfite. Benzenesulfonic acid was inert under these conditions in contrast to benzenesulfinic acid which reacted giving benzene and sulfite ion. Consequently it appears that the reaction of phenyl sulfone with caustic proceeds by initial formation of benzenesulfinate ion and phenol followed by basic hydrolysis of the sulfinate to benzene and sulfite ion. Since pure *p*-cresol free from *m*-cresol was formed on hydrolysis of *p*-tolyl sulfone, the first step was a direct displacement rather than a benzyne-type reaction.

Treatment of bromobenzene with *p*-toluenethiol and excess sodium amide in diglyme (diethyleneglycol dimethyl ether) formed phenyl *p*-tolyl sulfide. This reaction did not proceed in the absence of excess base, and *o*-bromoanisole gave the cine substitution product (*m*-methoxyphenyl *p*-tolyl sulfide) upon similar treatment leading to the conclusion that the benzyne mechanism was operating. Phenyl sulfone reacted under similar conditions (80°) giving excellent yields of phenyl *p*-tolyl sulfide. A benzyne mechanism rather than direct displacement seems probable for this reaction since under the same and even more vigorous conditions, phenyl sulfone remained completely unreactive towards sodium *p*-toluenethiolate in the absence of sodium amide.

Sodium amide induced a Smiles type rearrangement² of mesityl sulfone to 2,4-dimethyl-6-(2,4,6-trimethylbenzyl)-benzenesulfinic acid. The presence of *p*-toluenethiol did not affect the course of this reaction.

Sodium *p*-toluenethiolate reacted with bis-*o*-methoxyphenyl sulfone forming methyl *p*-tolyl sulfide in high yield. In this case sodium amide did not alter the nature of the reaction. A displacement on the methoxyl group was apparently facilitated by the *ortho* sulfonyl group.

In contrast to the behavior of phenyl sulfone, *p*-tolyl sulfone under the same treatment, did not give a sulfide product; only tars were formed. Furthermore, bis-*p*-*t*-butylphenyl sulfone was unreactive towards this treatment; however, at 150° *t*-butylbenzene was formed in high yield giving yet another type of base induced cleavage of a sulfone. The thiol was shown to have no effect on this reaction.

Dibenzothiophene dioxide was treated with *p*-toluenethiol and sodium amide giving a sulfinic acid which in turn was treated with strong aqueous base at 200° to remove the sulfinic acid group. The resulting product was 2-amino-biphenyl indicating a direct displacement by amide ion or

ammonia without rearrangement in spite of the presence of the thiol.

The reaction of *p*-tolyl sulfone with piperidine and sodium amide gave only *N-p*-tolylpiperidine and none of the *meta* isomer. This direct substitution without rearrangement is to be contrasted with the reaction of *p*-bromotoluene with piperidine and sodium amide resulting in the formation of both isomers via a benzyne intermediate. Methyl *p*-tolyl sulfone and *p*-toluenesulfonic acid each gave pure *N-p*-tolylpiperidine indicating direct displacements.

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1. J. D. Roberts, et al., *J. Am. Chem. Soc.*, **75**, 3290 (1953).
2. J. F. Bunnett and R. E. Zahler, *Chem. Revs.*, **49**, 362 (1951). Microfilm \$2.00; Xerox \$6.00. 123 pages.

THE SYNTHESIS AND REACTIONS OF FLUORINE-CONTAINING ORGANO-SILICON COMPOUNDS

(L. C. Card No. Mic 59-1731)

Charles Tomasino, Ph.D.
The University of Florida, 1959

The addition of $\text{CF}_2\text{BrCFClBr}$ to a series of alkenyl silicon compounds was studied. These compounds were vinyl dimethylethoxysilane, vinyl dimethylchlorosilane, di-vinyl dimethylsilane, allyl trimethylsilane, diallyl dimethylsilane, vinyl pentamethyldisiloxane and 1,3-divinyl-1,1,3,3-tetramethyldisiloxane. A mixture of products was obtained when two unsaturation sites were present as in 1,3-divinyl-1,1,3,3-tetramethyldisiloxane. This mixture consisted of the product of the addition to one vinyl group and the product of the addition to both vinyl groups.

An interesting phenomenon was observed in the addition of $\text{CF}_2\text{BrCFClBr}$ to allyl trimethylsilane. The olefin, $\text{CF}_2\text{BrCFClCH}_2\text{CH}=\text{CH}_2$, and bromotrimethylsilane were the products of this reaction. A mechanism involving the intermediate free radical was postulated to account for these products. It was further observed that the addition of the same haloalkane to diallyl dimethylsilane did not result in the formation of the cleaved products. Only a small portion of the reaction mixture was identified. This material was the result of the addition to one allyl group in which hydrogen bromide split out.

All attempts to dehydrohalogenate the addition products of the disiloxanes resulted in cleavage of the disiloxane bond. It was felt that some dehydrohalogenation occurred since potassium bromide was present in the reaction mixture. However, when the mixture was neutralized, several different disiloxane were undoubtedly reformed.

Unusual results were obtained when the addition products were treated with zinc and alcohol. Along with the expected dehalogenated product, a material was isolated in which replacement of the remaining α -bromine with hydrogen had occurred. This reduction was somewhat surprising in view of the ready formation of $\text{CF}_2=\text{CFCH}_2\text{CH}_2\text{Br}$ from $\text{CF}_2\text{BrCFClCH}_2\text{CH}_2\text{Br}$ without evidence of reduction.

Concentrated sulfuric acid selectively cleaved a methyl group from $\text{CF}_2\text{BrCFClCH}_2\text{CHBrSi}(\text{CH}_3)_3$. The resulting

sulfate ester readily hydrolyzed to the symmetrical di-siloxane. Microfilm \$2.00; Xerox \$3.00. 54 pages.

FACTORS CONTROLLING THE POSITION OF ALKYLATION OF ALKALI METAL SALTS OF PHENOLS

(L. C. Card No. Mic 59-2060)

Richard Clarence Tuites, Ph.D.
University of Illinois, 1959

The use of increasingly bulky alkylating agents has been found greatly to retard C-alkylation at an *ortho* position with alkali metal salts of 2,6-dimethylphenol. Thus, in the series of benzyl, benzhydryl and *t*-butyl chlorides, only benzyl chloride was found to give appreciable amounts of dienone formation. Similarly, in the alkylations of 2,6-dimethyl-, 2,6-diisopropyl- and 2,6-di-*t*-butylphenoxide salts with benzyl chloride, the yield of *C*-alkylated dienone decreased as the size of the *ortho* substituent increased. In both series, the yield of *O*-alkylated ether also decreased as the steric requirements became greater.

Alkylation of alkali metal salts of α - and β -naphthol and some of their derivatives as well as salts of anthrone have been observed to give a preponderance of *C*-alkylated products. An interesting phenomenon in the nuclear magnetic resonance spectra of several of the carbonyl-containing compounds produced has been observed, whereby two hydrogen atoms on the same carbon atom appear as a quartet in the N.M.R.

Alkylations on carbon in homogeneous mediums have been achieved with sodium and lithium 2,6-dimethylphenoxide. Evidence was also obtained for *C*-alkylation on sodium phenoxide in homogeneous media.

Microfilm \$2.00; Xerox \$7.00. 146 pages.

ADDITION OF HYDROGEN BROMIDE TO CYCLOHEXADIENE

(L. C. Card No. Mic 59-2425)

John Warkentin, Ph.D.
Iowa State College, 1959

Supervisor: George S. Hammond

This study was concerned with the polar addition of hydrogen bromide to 1,3-cyclohexadiene in pentane at -78° . Deuterium-enriched hydrogen bromide was used to provide a label in the 3-bromocyclohexene produced by the reaction.

The amounts of 1,2-addition and 1,4-addition were determined by chemical means, while the stereochemistry of the additions was inferred from chemical results and from infrared spectra in the carbon-deuterium region. Evidence for stereospecific allylic rearrangement of 3-bromocyclohexene was based on the assumption that 1,2-*cis*-addition did not occur.

It was found that polar addition of hydrogen bromide to 1,3-cyclohexadiene in pentane at -78° , goes about 20 per cent 1,2-*trans* and about 80 per cent 1,4-*cis*. Under the

conditions employed, about 32 per cent of the first-formed 3-bromocyclohexene had undergone allylic rearrangement.
Microfilm \$2.00; Xerox \$5.20. 102 pages.

**SYNTHESIS OF DIMETHOXYBENZIMIDAZOLES,
DIHYDROXYBENZIMIDAZOLES AND
IMIDAZOBENZOQUINONES AS
POTENTIAL ANTIMETABOLITES**

(L. C. Card No. Mic 59-2281)

Lester Weinberger, Ph.D.
University of Pennsylvania, 1959

Supervisor: A. R. Day

A number of 4,7-dimethoxy and dihydroxy benzimidazoles and imidazo-p-benzoquinones were prepared, having substituents in the 2 and 5 positions.

5,6-Dimethoxy and dihydroxybenzimidazoles were prepared. No derivatives could be prepared with substituents in the 4 position. The only 2-alkyl substituted compound which could be made in this series was the methyl derivative. The 2-chloromethyl derivative was used as an intermediate in the formation of a nitrogen mustard and a tertiary alkyl compound. The imidazo-o-benzoquinone could not be made.

The 5,6 and 4,7 dihydroxybenzimidazole were unstable as free bases. They were isolated as the hydrochloride or hydrobromide salts. The only compound stable as the free base is the 5-nitro-4,7-dihydroxybenzimidazole. This compound resisted oxidation to the quinone.

Imidazo-p-benzoquinone failed to give a number of reactions characteristic of quinones. The refractory nature of this quinone may be attributed to its unusual stability.

A triazine could not be made by the attempted diazotization of 2,3-diamino-1,4-dimethoxybenzene.

The 4,7-dimethoxybenzimidazole analog of folic acid could not be made.

Both nitro groups of 4,5-dinitro-veratrole were successfully reduced using palladium on charcoal catalyst, refuting the work of Bogert.

A case of steric inhibition of resonance was believed to be observed when 2,3-diacetamido-1,4-dimethoxybenzene would not brominate. Conversely, the 2-amino-3-acetamido-1,4-dimethoxybenzene compound readily brominated.

Microfilm \$2.00; Xerox \$4.00. 71 pages.

**A NEW ORGANIC REACTION: SPECIFIC
REPLACEMENT OF HYDROGEN BY
OXYGEN AT A STRUCTURALLY
UNACTIVATED METHYL GROUP**

(L. C. Card No. Mic 59-2064)

Robert Winslow White, Ph.D.
University of Illinois, 1959

In contradistinction to the well-known and well studied reactions of carbonium ions, the reactions of the analogous oxygen species, cationic oxygen, are little known. It has

been shown in this research that an oxygen cation which is in spatial proximity with a structurally unactivated methyl group will react with the methyl group to split out a proton, forming an ether. The methyl group and oxygen cation were brought into spatial proximity by synthesis of a cyclohexane system, 1,3,3-trimethylcyclohexyl hydroperoxide, in which the two groups are in a 1, 3 diaxial conformation. Generation of the cationic oxygen could be brought about by decomposition of the peroxidic bond via aryl carboxyl and sulfonyl esters of this hydroperoxide. The aryl sulfonyl esters decomposed rapidly and could not be isolated. However, the aryl carboxyl esters are stable at room temperature and rearrangement was effected by Lewis acids.

The requisite hydroperoxide was synthesized from the corresponding alcohol by treatment with hydrogen peroxide, sulfuric acid, and trichlorofluoromethane as an organic solvent.
Microfilm \$2.00; Xerox \$3.00. 45 pages.

**I. LEAD TETRAETHYL AS INITIATOR FOR
POLYMERIZATION REACTIONS.
II. POLYMERIC DIELS-ALDER REACTIONS.
III. POLYMERIZATION OF OLEFINIC SILANES.**

(L. C. Card No. Mic 59-2067)

Robert Graham Woolford, Ph.D.
University of Illinois, 1959

I.

Monomers containing functional groups (e.g. vinyl chloride, acrylonitrile) usually are not polymerized by normal Zeigler-type catalysts, such as aluminum triisobutyl-titanium tetrachloride. Instead, the catalyst appears to be destroyed. Attempting to solve this problem, some of the heavier, less reactive metal alkyls were studied. Cadmium dimethyl, mercury dibutyl and lead tetraethyl were used both in Zeigler-type systems and alone. The monomers were ethylene, butadiene, styrene, vinyl chloride, vinyl acetate, acrylonitrile and methyl methacrylate.

Lead tetraethyl gave the best results, especially with methyl methacrylate and acrylonitrile. The most thorough investigation was carried out on polymerizations of acrylonitrile using lead tetraethyl alone and lead tetraethyl-titanium tetrachloride mixtures. The latter catalyst was effective in certain cases where the former was not. The presence of light, especially ultraviolet light, was not only beneficial but a necessity in low temperature reactions (around room temperature). The polymers obtained had inherent viscosities of 0.9-5.0 but were not highly crystalline.

This work represents the first example of polymerization of monomers such as acrylonitrile using a type of Zeigler catalyst.

II.

The synthesis of a bifunctional diene for use in a poly-Diels-Alder reaction was undertaken. 2,2'-p-Phenylenedibutadiene, 2,2'-p,p'-biphenylenedibutadiene and 1,3,6,8-nonatetraene were the dienes chosen. However, the isolation of these dienes was not successful. This is believed due to their extreme reactivity (or instability). During

this investigation, a number of synthetic intermediates related to 2-phenyl-1,3-butadiene was prepared (for example, p-phenylene-bis(methylvinylcarbinol), p-phenylene-bis-(methylvinylchloromethane) and others). 2-Phenyl-1,3-butadiene was prepared in an efficient two-step synthesis from acetophenone and vinylmagnesium bromide, followed by dehydration. This is believed to be the most suitable preparation of this diene to date. Also, the first condensation of an aliphatic dialdehyde (glutaraldehyde) with a Grignard reagent (vinylmagnesium bromide) was accomplished to yield 3,7-dihydroxy-1,8-nonadiene. It is believed that this preparation is a general one.

III.

Since the silicon-carbon bond in many organic silanes has shown outstanding thermal stability, it was hoped to prepare high molecular weight polymers of the polysilethylene and polysilpropylene type. The monomers studied were diphenylvinylsilane, bis(m-perfluoromethylphenyl)vinylsilane and allyldimethylsilane. Polymerization of these silanes in a wide variety of emulsion systems were unsuccessful. Low molecular weight polymers of diphenylvinylsilane were made using such catalysts as palladium-charcoal, platinum oxide, chloroplatinic acid and others. These catalysts had not been used previously in polymerizations.

The polymerization of diallyldimethylsilane with an aluminum triisobutyl-titanium tetrachloride catalyst was also studied. Soluble polymers which contained cyclic recurring units were obtained. Depending on reaction conditions, these polymers ranged from high melting solids to viscous oils. Microfilm \$2.15; Xerox \$7.60. 161 pages

CHEMISTRY, PHARMACEUTICAL

DERIVATIVES OF PIPERAZINE. XXII. SYNTHESIS OF SOME 3- $\{\omega$ -[4-(ARYL)-1-PIPERAZINYL]-ALKOXY}-PROPIONITRILES.

(L. C. Card No. Mic 59-1723)

Ronald John Brenner, Ph.D.
The University of Florida, 1959

The wide spectrum of physiological activity exhibited by derivatives of piperazine suggested that the preparation of additional compounds of this type might be fruitful of substances of therapeutic usefulness. Therefore, it was decided to prepare a series of unsymmetrical 1,4-disubstituted piperazines.

The preparation and physical properties of twenty-eight unsymmetrical 1,4-disubstituted piperazines have been reported. These include fourteen 3- $\{\omega$ -[4-(aryl)-1-piperazinyl]-alkoxy}-propionitriles, seven 1-aryl-4-(2-carbomethoxyethyl)-piperazines, and seven 1-aryl-4-(3-hydroxypropyl)-piperazines. The last two groups were necessary intermediates for the preparation of the compounds described in the title. All of the substances synthesized in this investigation have not been previously reported in the literature.

Each of the substances prepared will be submitted for

pharmacological testing. Further syntheses will be guided by the results of these tests.

Microfilm \$2.00; Xerox \$4.40. 83 pages.

THE SYNTHESIS AND PHARMACOLOGY OF SEVERAL DIALKYLAMINOALKYL ESTERS OF INDOLE CARBOXYLIC ACIDS

(L. C. Card No. Mic 59-2527)

Samuel Elkin, Ph.D.
University of Maryland, 1958

Supervisor: F. M. Miller, Ph.D.

The largest number of compounds synthesized for local anesthetic purposes are the alkamine esters of aromatic acids. The most prominent anesthetic of this type is β -diethylaminoethyl p-aminobenzoate (Procaine). Many modifications of Procaine have been prepared which had varying degrees of effectiveness as local anesthetics.

In this work, several indole carboxylic acids were incorporated as the acid portion of the ester. The following compounds have been synthesized in the form of their hydrochloride salts by treating the acids with a dialkylaminoalkyl chloride in isopropanol: 2-Diethylaminoethyl indole-3-carboxylate, 3-diethylaminopropyl indole-3-carboxylate, 2-diethylaminoethyl 6-nitroindole-3-carboxylate, 3-diethylaminopropyl 6-nitroindole-3-carboxylate, 2-diethylaminoethyl indole-2-carboxylate, 3-diethylaminopropyl indole-2-carboxylate.

All of the above compounds were effective as topical anesthetics, but had no action on unbroken skin. 2-Diethylaminoethyl indole-3-carboxylate hydrochloride and 3-diethylaminopropyl indole-3-carboxylate hydrochloride were more potent than either cocaine or procaine. Nitration of indole-3-carboxylic acid reduced the activity of the esters. The local anesthetic potency was markedly reduced in those compounds in which the carboxyl group was in the 2-position.

Microfilm \$2.00; Xerox \$3.00. 36 pages.

THE PREPARATION OF SUBSTITUTED INDOLINES WITH POSSIBLE PSYCHOPHARMACOLOGIC INTEREST

(L. C. Card No. Mic 59-2530)

Bernard Francis Grabowski, Ph.D.
University of Maryland, 1958

Supervisor: F. M. Miller

A review of a number of physiologically active indole alkaloids, i.e., gramine, the bufotenines, the harmala alkaloids, physostigmine, ajmaline, ibogaine, yohimbine and reserpine, showed them to have certain structural similarities. It was noted that they all contain an indole or indoline moiety as a part of their molecule and an ethylamino linkage at C-3 of the indole or indoline moiety. In most cases, the nitrogen of the ethylamino bridge is

tertiary. Also, a hydroxyl or methoxyl grouping is present in a number of these alkaloids in the C-5 or C-6 position of the indole or indoline moiety. From these structural similarities we undertook for our work the preparation of substituted indolines incorporating the structural features mentioned above.

The new compounds prepared in this work include 3-(dimethylaminomethyl)-1,3-dimethylindoline; 3-(2-diethylaminoethyl)-5-methoxy-3-methylindoline; 3-(2-dimethylaminoethyl)-5-methoxy-1,3-dimethylindoline; 3-(2-diethylaminoethyl)-5-methoxy-1,3-dimethylindoline and 3-(3-dimethylaminopropyl)-5-methoxy-1,3-dimethylindoline. The alkylated 5-methoxy-3-methyl- and 5-methoxy-1,3-dimethylindoles, from which the alkylated indolines were obtained by reduction with lithium aluminum hydride, are also an unreported series of compounds. Infra-red spectrographs of these substituted oxindoles and indolines are also included in this report.

Although the pharmacology of these compounds is as yet unknown, possible hypotensive, tranquilizing and/or hallucinogenic activity is anticipated as is common to many of the naturally occurring indole alkaloids.

Microfilm \$2.00; Xerox \$3.00. 43 pages.

THE SYNTHESIS OF SOME GLYCIDIC ESTERS AS POTENTIAL ANTISPASMODICS

(L. C. Card No. Mic 59-2366)

Gary Wilson Omodt, Ph.D.
University of Minnesota, 1959

Atropine, which is a potent smooth muscle antispasmodic, has furnished a nucleus after which many active synthetic antispasmodics have been patterned. According to Pfeiffer's theory, an active antispasmodic is attracted to and held by its neuroreceptor by virtue of the N-methyl grouping, the ester carbonyl and ester ether oxygen. If one examines a Fisher-Taylor-Hirschfelder model of a tropeine, it can be seen that combination of the molecule with its neuroreceptor is possible from one side and one side only, i.e., the side exposing the N-methyl grouping. The endo-ethylene bridge would seem to prevent combination from the other side. If these steric considerations are correct, the acyl portion of a tropeine would have to be rotated at the ether oxygen so that the carbonyl would be on the correct side of the molecule for receptor combination. When this is done with a model of a tropeine, it can be seen that the distance between the N-methyl and the carbonyl will have a certain value. This value cannot be attained when one uses a model of a pseudotropeine and this would apparently explain the low antispasmodic activity of pseudotropeines as compared to tropeines.

When one makes a Fisher-Taylor-Hirschfelder model of 3-tropilidene acetic ester, the N-methyl-carbonyl distance can be seen to have approximately the same value as the N-methyl-carbonyl distance of a tropeine. This would indicate that tropilidene compounds of this type should possess activity resembling the activity of atropine. However, compounds of this type are not easily synthesized due to possible migration of the double bond during the reaction sequence.

Since an epoxy grouping would confer similar structural

effects on the total confirmation of the molecule as would a double bond, a series of glycidic esters was prepared utilizing 1-methyl-4-piperidone and tropinone as the reactant ketones in the conventional Darzens condensation. 1-Methyl-4-piperidone was prepared via the Dieckmann cyclization condensation of di- β -ethoxycarbonyl ethylmethylamine and tropinone was prepared via the Robinson synthesis. The two amino ketones were condensed with ethyl chloroacetate utilizing sodium hydride suspension in mineral oil as the basic catalyst (with a small amount of absolute ethanol). The two Darzens products were transesterified with benzohydrol and a hydrochloride was prepared of each. Benzohydrol was used as the transesterifying alcohol since diphenylacetyl tropine shows a relatively high order of antispasmodic activity. The two benzohydryl glycidic esters should resemble quite closely diphenylacetyl tropine in overall structure. These first two benzohydryl glycidic esters were pharmacologically evaluated as to their antispasmodic activity in this laboratory. The results of the evaluation indicated in a qualitative and semi-quantitative manner that the two esters were active as antispasmodics.

Dicyclohexylmethyl, cyclohexyl and 1-methyl-4-piperidyl glycidic esters were also prepared by submitting the first two ethyl glycidic esters to transesterification with the appropriate alcohol. Dicyclohexylmethanol was prepared via the Grignard reaction between ethyl formate and cyclohexane magnesium bromide. 1-Methyl-4-piperidinol was prepared by sodium borohydride reduction of 1-methyl-4-piperidone. The glycidic esters so prepared were derivatized as hydrochlorides, p-toluene sulfonates and picrates. The 1-methyl-4-piperidyl glycidic esters were derivatized as methyl bromides in an attempt to introduce ganglionic blocking ability.

An unsuccessful attempt was made to prepare alkyl glycidic esters utilizing isopropylidene teloidinone as the reactant ketone. The ethyl glycidic ester was prepared but when an attempt was made to transesterify it with benzohydrol, only starting material could be isolated from the reaction mixture.

Several attempts were made to prepare some N-substituted glycidic amides but without success.

All compounds will be screened for pharmacological activity. Microfilm \$2.00; Xerox \$4.60. 88 pages.

A STEREOSPECIFIC SYNTHESIS OF SHIKIMIC ACID

(L. C. Card No. Mic 59-1184)

John Taiyoung Suh, Ph.D.
The University of Wisconsin, 1959

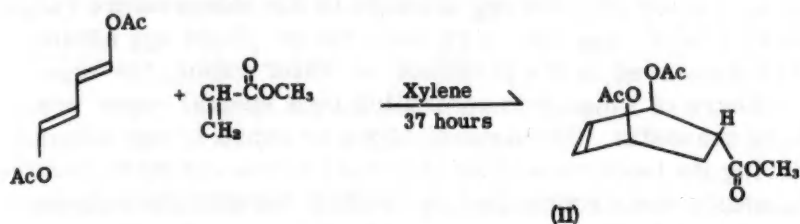
Supervisor: Associate Professor E. E. Smissman

A synthetic method with a straightforward approach which would lead to the correct stereochemistry of shikimic acid (I), 3,4,5-trihydroxycyclohexene-1-carboxylic acid, has been realized.

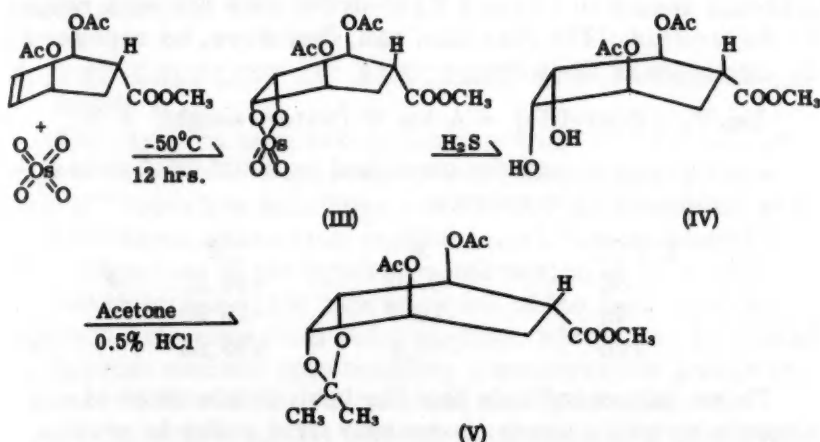
Shikimic acid is known to be an important intermediate for certain strains of *Escherichia coli* and *Neurospora Crassa* in the biosynthesis of tyrosine, phenylalanine, p-aminobenzoic acid, and p-hydroxybenzoic acid.

trans,trans-1,4-Diacetoxybuta-1,3-diene, prepared by

the method described by Reppe and co-workers (Ann. Chem. 560, 1-92, 1948), and methyl acrylate was allowed to undergo Diels-Alder reaction and methyl 3,6-cis-diacetoxycyclohexene-4-carboxylate (II) was obtained.

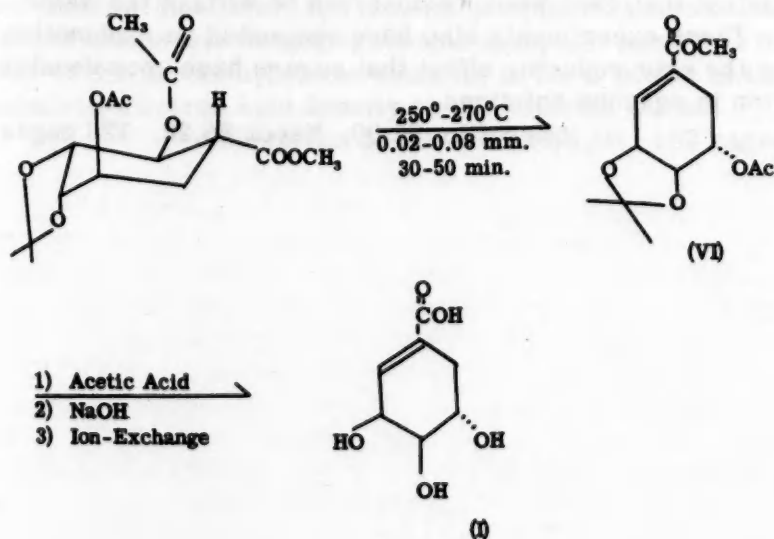


The mixture of methyl 3,6-cis-diacetoxycyclohexene-4-carboxylate, osmium tetroxide, and anhydrous pyridine was allowed to react at -50°C for 12 hours. The brown osmium complex (III) in methylene dichloride was decomposed with hydrogen sulfide and methyl 2 β ,5 β -diacetoxycyclohexyl-1-carboxylate (IV) was obtained. Methyl 2 β ,5 β -diacetoxycyclohexyl-1-carboxylate (IV) was prepared by allowing the cis-diol (IV) to react with acetone containing 0.5% hydrochloric acid for 19-30 hours at room temperature.



Various bases (sodium bicarbonate, sodium carbonate, sodium hydroxide, sodium methoxide, potassium tert-butoxide, and IRA-400) were used for β -elimination studies of methyl 2 β ,5 β -diacetoxycyclohexyl-1-carboxylate (IV) and its corresponding acetonide (V) with no success.

Methyl 2 β ,5 β -diacetoxycyclohexyl-1-carboxylate acetonide readily undergoes pyrolytic β -elimination in a sealed tube at 250° - 270° and 0.02-0.08 mm. pressure. dl-Methyl 3-acetylshikimate-4,5-acetonide (VI) was obtained in 60-72% yield.



dl-Methyl 3-acetylshikimate-4,5-acetonide was prepared by the method given by H. O. L. Fischer (Helv. Chim. Acta. 20, 708 (1937)) and the IR spectra in chloroform and UV spectra ($E_{214\text{ m}\mu}^{\text{MeOH}}$ 9,000) of the natural (I) acetonide were identical with those of the synthetic dl-acetonide. Thus, the ease of the pyrolysis and the high yield of pyrolysis product suggest that the stereochemistry at C₁-carboxylate and C₂-acetoxy is trans.

dl-Methyl 3-acetylshikimate 4,5-acetonide was converted to dl-shikimic acid by treatment of the acetonide with acetic acid followed by basic hydrolysis. The dl-acid, isolated by ion-exchange chromatography, is being investigated for biological activity on *Escherichia coli* mutant 81-3.

Microfilm \$2.00; Xerox \$4.20. 78 pages.

ANALOGUES OF RESERPINE: II. NEW ESTERS OF 3,4,5-TRIMETHOXYBENZOIC ACID

(L. C. Card No. Mic 59-2542)

Myron Simon Weinberg, Ph.D.
University of Maryland, 1958

Supervisor: Associate Professor F. M. Miller

The determination of the active portion of the alkaloid reserpine was undertaken by the author in 1955 and in 1956 the preparation of simple aminoalkyl esters of 3,4,5-trimethoxybenzoic acid was reported. These simple esters, analogous to ring E of the pentacyclic alkaloid, were shown to be inactive as tranquilizers. Therefore a second phase of the structure-activity study was undertaken in which two new series of 3,4,5-trimethoxybenzoyl esters were prepared. These esters were analogous to rings D and E of the pentacyclic alkaloid.

The new compounds prepared in this work include tetrahydro- and perhydroisoquinolines substituted in the 6 or 7 position with the 3,4,5-trimethoxybenzoyl moiety. The compounds in this series which are reported are esters of 1,2,3,4-tetrahydro-6-isoquinolol, 6-perhydroisoquinolol, 1,2,3,4-tetrahydro-2-methyl-6-isoquinolol, 2-methyl-6-perhydroisoquinolol, 1,2,3,4-tetrahydro-7-isoquinolol, 7-perhydroisoquinolol, 1,2,3,4-tetrahydro-2-methyl-7-isoquinolol and 2-methyl-7-isoquinolol.

These substances were screened for reserpine-like activity by examining intact animals, to whom the esters had been administered, for several of the physiological changes which have been previously demonstrated to occur after administration of the alkaloid. The various esters were injected into normotensive, unanesthetized dogs and rabbits and the following data were recorded: blood pressure of the dogs before and after administration; mydriasis in the rabbits, excretion of 5-hydroxyindoleacetic acid by the rabbits; and the comparison of activity of these animals with that of untreated rabbits.

All of the esters tested caused lowering of blood pressure in the dogs. 2-Methyl-6-perhydroisoquinolyl 3,4,5-trimethoxybenzoate was the most active compound in this series, with several of the test animals expiring after administration of this drug. None of the compounds tested showed activity in the other phases of the screening program and it was concluded that these isoquinoline derivatives had hypotensive activity but did not represent the

active portion of the reserpine molecule. Nevertheless, the isoquinolyl moiety of the alkaloid (rings D and E) was not ruled out as the active portion of the alkaloid since the stereochemistry of the compounds prepared has not been shown to correspond to that of the alkaloid.

With the failure of the synthetic isoquinolyl derivatives to produce satisfactory reserpine-like activity a third phase of the study was undertaken; the preparation of 2-(6-methoxy-3-indolyethylamino)ethanol and its 3,4,5-trimethoxybenzoate was attempted. The starting material for the preparation of this compound was to be 6-methoxyoxindole, a compound which had not been previously reported in the literature. The preparation of the oxindole derivative was attempted using the Bayer and the Stolle syntheses. Neither method was successful nor was the preparation of the oxindole derivative by diazotization of 6-aminooxindole and hydrolysis to 6-hydroxindole. With repeated failure to prepare this material this phase of the study was abandoned.

Finally the preparation 17-yohimbyl 3,4,5-trimethoxybenzoate is reported. This compound was tested for blood pressure effects on normotensive, unanesthetized dogs and shown to cause elevation of blood pressure in these animals in doses of 10 mg per kg.

Microfilm \$2.00; Xerox \$3.00. 46 pages.

CHEMISTRY, PHYSICAL

THE ROLE OF WATER IN THE HEAT DENATURATION OF EGG ALBUMIN

(L. C. Card No. Mic 59-1836)

Robert Leon Altman, Ph.D.
University of Southern California, 1959

Chairman: Professor S. W. Benson

The binding of water vapor to native and denatured egg albumin has been investigated with a McBain sorption balance. This extensive investigation of water sorption has been conducted at 25, 40, 55, 60, 70, 80, 90 and 100° C. Sorption hysteresis was observed over the entire relative humidity range from 25 to 70° C. The sorption data indicate that the extent of hysteresis decreases with increasing temperature. At temperatures above 70° C. this hysteresis is absent at the uppermost portion of the sorption isotherm.

Detailed computation has shown that the hysteresis effect is related to a change in the thermodynamic properties of the sorbed water. Desorbed water is apparently more strongly bound to the protein substrate than is adsorbed water when sorption hysteresis occurs. It is found that the entropy and enthalpy of adsorbed water are decreased when isothermal desorption to the same partial pressure takes place.

Different ways of denaturing egg albumin yield different water sorption isotherms in the 25 to 40° C. temperature range. Steam denaturation seems to enhance the water-binding affinity of this protein, whereas boiling or alcohol-coagulation reduces it. These results suggest that the end product of the denaturation process is not a definite ther-

modynamic state but rather one dependent upon the method of denaturation.

A semiquantitative investigation of the effect of water vapor, at constant relative humidity, upon the rate of heat denaturation of solid egg albumin in the temperature range 60 to 100° C. has also been undertaken. Solid egg albumin was denatured in the presence of water vapor, the vapor pressure of which was controlled by a special vapor pressure manostat. The amount of water bound to egg albumin during its isothermal heat-denaturation at constant relative humidity was ascertained by reading directly the manostat developed for these experiments.

This study of the rate of denaturation of solid egg albumin in the presence of water vapor has shown how important water is in the denaturation process. It has been found that the rate of denaturation of this protein is measurable only when the relative humidity of water becomes greater than 50 per cent. These experiments could be carried out only under such partial pressure and temperature conditions in which water-sorption hysteresis is no longer present.

It has been observed that the denaturation of solid egg albumin seems to follow a first-order rate law with respect to the protein. The rate data can, therefore, be represented by equations of the form:

$$\log T_{1/2} \text{ (half-life)} = A \log W \text{ (water-weight)} + B.$$

Straight lines through the smoothed experimental points have the following constants:

T (°C.)	A	B
80	-9.40	+10.21
90	-16.7	+16.90
100	-11.8	+10.92

These values indicate that the heat denaturation of egg albumin by water vapor, seemingly first order in protein, is some tenth to fifteenth order in W, the amount of bound water. It can also be shown that the activation energy for this process lies in the range 60 to 100 kilocalories per mole.

The high order with respect to water suggests that hydrophilic protein bonds can be broken only after they have been saturated with many water molecules or that the role of water in the denaturation process is that of a "lubricant." By this is meant that though the water probably sorbs both between and within the protein molecules, its importance lies in the fact that it be in such a physical state that the protein chains are made freer to uncoil under thermal excitation than they would themselves be without the water.

These experiments also have suggested an explanation for the rate-reducing effect that sugars have upon denaturation in aqueous solutions.

Microfilm \$2.00; Xerox \$6.20. 128 pages.

SPIN COUPLING IN RADIO FREQUENCY
SPECTROSCOPY: A. THE ELECTRON
COUPLING OF NUCLEAR SPINS.
B. THE COUPLING OF ELECTRON
AND NUCLEAR SPINS.

(L. C. Card No. Mic 59-1997)

David Hamel Anderson, Ph.D.
University of Illinois, 1959

A. THE ELECTRON COUPLING OF NUCLEAR SPINS

A valence bond theory, based on the approximate second-order perturbation method of Ramsey, is developed for the calculation of the electron coupled nuclear spin interactions in a Σ molecule. A detailed application of the theory to methane leads to a numerical value for the coupling constant in agreement with the experimental result. The result indicates that the proton-proton coupling constant, for non-bonded protons, is an exceedingly sensitive measure of deviations from perfect pairing. The contributions of the non-perfect pairing structures to the ground state wave function are, however, so small that they have little effect on the energy.

B. THE COUPLING OF ELECTRON AND NUCLEAR SPINS

The electron spin resonance spectrum of the free radical, tetrafluoro-p-benzoquinone ion, is presented. The F^{19} hyperfine splittings are concluded to arise by a configuration interaction-contact interaction mechanism. The magnitude of the hyperfine interaction is then interpreted in terms of the hybridization of the fluorine bond. Approximate empirical relationships, which may be useful in fluorine nuclear spin coupling considerations and in the valence theory of fluoro-carbons, are developed.

The proton magnetic resonance spectra of potassium naphthalenide and 1,1-diphenyl-2-picrylhydrazyl (DPPH) at $T = 77^\circ$ and $T = 298^\circ$ are presented. The potassium naphthalenide is observed to have a shift which is independent of temperature, and although this is consistent with a conducting solid model, there is no other evidence in support of this model. The spectrum of the free radical, DPPH, at $T = 77^\circ$ is interpreted as evidence for the existence of positive and negative unpaired electron spin densities in the molecule. An elementary valence bond calculation of the spin densities on the carbon and nitrogen atoms in DPPH, shows that the spin densities expected for the nitrogens are in reasonable agreement with the electron resonance experiments. Moreover, the calculated spin densities on the carbon atoms and the experimental spectrum show that the sign of the proton hyperfine constant is the opposite of the unpaired electron spin density on the adjacent carbon.

Microfilm \$2.00; Xerox \$6.00. 122 pages.

COLLISIONAL PROCESSES IN
GAS PHASE KINETICS

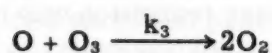
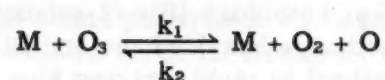
(L. C. Card No. Mic 59-1837)

Arthur Edward Axworthy, Jr., Ph.D.
University of Southern California, 1959

Chairman: Professor Sidney W. Benson

The role of collisional, energy-transfer processes in gas phase kinetics has been investigated both theoretically and experimentally. The detailed, collisional theory of gas phase kinetics which was developed predicts the correct pressure dependence for reactions of all degrees of molecularity. The unique feature of this theory is the recognition of two types of critically activated complexes—those associated with the reactants and those associated with the products.

Since the rate of the thermal decomposition of ozone was known to be dependent on the rate of a collisional, energy-transfer process, the mechanism of this reaction was re-investigated in detail. It was found that most of the known data on the pyrolysis of ozone may be quantitatively explained on the basis of the simple atomic mechanism,



where $k_1 = 4.61 \times 10^{12} \exp(-24,000/RT)$ L/M-sec
 $k_1 k_3 / k_2 = 2.28 \times 10^{15} \exp(-30,600/RT) \text{ sec}^{-1}$
 and $(M) = (O_3) + 0.44(O_2) + 0.41(N_2) + 0.34(He) + 1.06(CO_2)$.

There is no evidence for a direct bimolecular reaction of ozone to produce oxygen nor is there any evidence for important surface effects or energy chains in the decomposition of pure ozone. On the other hand, the results at very fast rates of decomposition indicate an acceleration which can be accounted for in terms of a self-heating effect.

Accidental trace catalysis was found to be an especially difficult problem in the investigation of the rate of this reaction, but it was not possible to determine the exact nature of the materials which were responsible for this catalytic effect. It was shown, however, that water was not an important catalyst. The marked susceptibility of the rate of this reaction to trace contaminants no doubt accounts for much of the difficulty which has been encountered in the past in investigating the mechanism of this reaction.

The first step in the decomposition of ozone is shown to be a unimolecular reaction which is at its low-pressure limit. The collisional transfer of energy to ozone is found to be a relatively inefficient process, and this accounts for the absence of energy chains in the pyrolysis of ozone. In terms of these results, it can be shown that the high quantum yields obtained in the photolysis of ozone at short wave lengths are not the result of hot oxygen molecule energy chains, as is usually assumed, but rather are probably the result of a photon energy chain which derives from $[^1D]$ oxygen atoms which can form in the primary photochemical process at these short wave lengths.

From the rate constants obtained in this investigation, the thermal explosion limits for pure ozone can be estimated. These results show that a practical limit is placed

on the concentration range over which the rate of this reaction may be measured.

In terms of the proposed mechanism for the decomposition of ozone, it is shown that oxygen atoms may be formed from oxygen molecules at very high temperatures by a reaction which involves ozone as an intermediate. Although this reaction is not of importance in the pyrolysis of ozone, it could lead to some interesting results in certain high-temperature kinetic investigations.

Microfilm \$4.25; Xerox \$14.40. 331 pages.

SOLUTIONS OF ALKALI METALS IN POLYETHERS

(L. C. Card No. Mic 59-2438)

Fred A. Cafasso, Ph.D.
New York University, 1959

Adviser: Dr. Benson R. Sundheim

It has been observed that alkali metals dissolve in 1,2 dimethoxyethane and its higher homologs (Bis (2-ethoxy-methyl) ether, 1,2-Bis (2-methoxyethoxy) ethane and Bis (2-(2-methoxyethoxy)ethyl) ether) to yield striking blue solutions. A blue to bronze-like phase transition was observed to occur in two of the metal-ether systems.

Two of the systems have been characterized. The characterization included solubility, electrical conductance, transference, electron paramagnetic resonance spectra and absorption spectra measurements.

Factors affecting the stability of the solutions are discussed and handling techniques are described.

Solubility measurements indicated that potassium, rubidium and cesium metals are soluble in the ether systems whereas sodium is not. The metal solutes exhibited a negative temperature coefficient of solubility. It has been observed, however, that sodium may be carried into solution by a saturated potassium-1,2 dimethoxyethane solution. A possible mechanism for this effect has been put forward.

The conductance of potassium in 1,2 dimethoxyethane has been measured as a function of temperature. The equivalent conductance was observed to decrease continuously as the temperature is lowered. Ion-association is used to explain the observed behavior.

Qualitative transference measurements were conducted with a potassium-1,2 dimethoxyethane solution. The conduction process was determined to be electrolytic and the charge of the blue species in the solution was established in this way.

No free spins were detected in any of the ether solutions, except rubidium in Bis (2-(2-methoxyethoxy)ethyl) ether, examined with a electron paramagnetic resonance spectrometer. The implications of these results are discussed in conjunction with the spectral data.

A special Dewar-vessel, designed to contain a 2 mm optical cell and for use with a Beckman D.K. Spectrophotometer has been described. The absorption spectra of potassium, cesium and rubidium solutions in 1,2 dimethoxyethane and Bis (2-(2-methoxyethoxy)ethyl) ether have been recorded. A single visible or near infrared absorption maximum accompanied by a region of continuous

absorption which extended through the visible into the ultra-violet region was characteristic of all the spectra.

The structural features of the ether molecules which may account for this phenomenon were examined and a suitable model has been proposed for the metal-polyether solutions. The model has been shown to be compatible with most of the observed chemical, electrical, magnetic and optical properties of the systems.

The possible analogy to alkali metal-liquid ammonia and amine solutions is noted. The results of this investigation have been compared to the chemical, magnetic and optical properties of similar metal solutions in liquid ammonia and amine solvents.

The preliminary results of an investigation, started before our attention was diverted to the alkali metal-ether solutions, is appended. In this work, the thermodynamic properties of sodium-potassium alloy were to be determined as functions of composition and temperature. The activity coefficients of the components were to be determined via the partial pressures which, in turn, were to be measured spectrophotometrically. The corrosive nature of the alkali metals at elevated temperatures necessitated special design features in the absorption cell. A technique is described for effecting window seals which maintained a high vacuum (10^{-5} millimeter of mercury), withstood prolonged exposure to sodium and potassium vapors at 300°C . and allowed cooling, cleaning, and recycling processes to be performed without losing their tightness.

Microfilm \$2.00; Xerox \$5.60. 114 pages.

GASEOUS DISSOCIATION STUDIES OF SOME OXYGEN-BORON AND SULFUR-BORON ADDITION COMPOUNDS

(L. C. Card No. Mic 59-890)

James Franklin Carpenter, Ph.D.
St. Louis University, 1958

Molecular addition compounds of the type formed from the Group III Lewis acids and the Groups V and VI Lewis bases have excited considerable interest because of the unusual valence problems which they pose. These compounds have a wide range of stabilities and, as more is learned of compounds of this type, it becomes evident that there is no simple means of predicting their relative stabilities.

This dissertation is chiefly concerned with the study of the relative stabilities of five molecular addition compounds of boron. The compounds investigated include: diethylether-borontrifluoride, tetrahydrofuranborontrifluoride, tetrahydrothiophene-borane, tetrahydrothiophene-borontrifluoride, and tetrahydrofuran-borane.

The method of study involves the thermal dissociation of the complex in the gas phase. Determination of the gas-phase dissociation pressures over a range of temperatures affords data for the calculation of the changes in enthalpy, free energy and entropy for the dissociation reaction.

The cyclic ether ($\text{C}_4\text{H}_8\text{O}$) and the analogous cyclic thioether ($\text{C}_4\text{H}_8\text{S}$) afford a basis for comparing the electron donor power of sulfur and oxygen ligands towards the Lewis acids boron trifluoride (BF_3) and borane (BH_3). By using these cyclic ligands steric effects are minimized and the donor atoms are subjected to similar inductive effects.

With boron trifluoride as the reference acceptor molecule, the electron donor power of the oxygen ligand is shown to be greater than that of the sulfur ligand. The opposite order is indicated when borane is used as the reference acid.

When tetrahydrothiophene is the reference base, borane is shown to be a stronger acid than boron trifluoride. The orders of coordination are reversed when tetrahydrofuran is the reference base.

This research indicates the relatively high stability of tetrahydrothiophene-borane. Until recently this result would have been described as "unusual" or "anomalous." However, it is now believed that there is a transfer of electron density from the B-H bonds to atoms bonded to boron having suitable vacant orbitals. Thus, a form of pi bonding supplements the normal donor-acceptor bond. A comparison of the dissociation heats of tetrahydrothiopheneborane and tetrahydrothiophene-borontrifluoride indicates that the pi bonding contribution to the over-all bond strength of the sulfur-boron bond is considerable if the most recent value for the dissociation enthalpy of diborane is accepted.

The dissociation heats of tetrahydrothiophene-borontrifluoride and tetrahydrofuran-borontrifluoride is used to compare the relative strength of the oxygen-boron and the sulfur-boron coordinate bonds. No pi bonding would be expected with boron trifluoride as the common acceptor molecule.

The importance of steric effects on the stability of addition compounds is shown by the pronounced difference in the change of free energies for the dissociation of diethyl-ether-borontrifluoride and tetrahydrofuran-borontrifluoride. This comparison has been made previously in the literature, but was based on results of questioned accuracy. It was considered worthwhile to redetermine the thermodynamic stabilities of these compounds as a part of the related series of compounds investigated.

Microfilm \$2.00; Xerox \$4.20. 77 pages.

NUCLEAR MAGNETIC RESONANCE STUDY OF FLUORINE IN SILVER FLUORIDE AND SILVER SUBFLUORIDE

(L. C. Card No. Mic 59-1611)

Q. Won Choi, Ph.D.
Purdue University, 1959

Major Professor: J. M. Honig

A new method of preparing silver fluoride has been developed, which represents a modification of the procedure by Tapilov et al (1955): Silver metal is dissolved in hydrofluoric acid by addition of hydrogen peroxide solution. The procedure of Anderson and Bak (1953) can then be utilized to precipitate anhydrous silver fluoride by adding methanol and ether in succession to the aqueous solution.

The silver fluoride solution was also used directly for preparing silver subfluoride in a very finely divided state. Ag_2F crystals were first prepared by warming a mixture of silver fluoride solution and silver powder; the subfluoride formed was then decomposed by using the least possible amount of water. The resulting silver is present in a

very finely divided state and forms fairly fine Ag_2F powder when warmed with a concentrated solution of silver fluoride. It has been found that the presence of a slight amount of free hydrofluoric acid does not disturb the formation of Ag_2F .

Nuclear magnetic resonance line shifts of fluorine in AgF and Ag_2F have been measured, relative to the fluorine resonance line of an aqueous solution of potassium fluoride. The percentage shifts are -0.009 and +0.014, respectively; the positive shift corresponds to higher external magnetic resonant field at a fixed frequency. The line widths are approximately 3.3 and 4.3 gauss for AgF and Ag_2F , respectively; in the case of Ag_2F , an uncertainty is introduced by the rather high level rf fields used to obtain the absorption signal. The shift of the fluorine line in Ag_2F lies between that of CF_4 and ClF_3 , whereas the AgF fluorine nucleus exhibits the largest shift reported so far.

The present data cannot be interpreted by any of the current concepts which are admittedly not very refined. According to the simplified theory of Saika and Slichter (1954) and Yosida and Moriya (1956), an increased covalency in an ionic bond results in a decreased shift. From this point of view, the fluorine atom in AgF would be more ionic in character than that in HF , and the fluorine atom in Ag_2F would possess more covalent character than the fluorine atoms in CF_4 . However, it is difficult to picture that any appreciable covalency should occur in fluorine ions that are packed in planar lattices, sandwiched between layers of silver ions in Ag_2F . The other possible cause for the smaller value of $\Delta\sigma$ for Ag_2F may be the hyperfine interaction known as the Knight shift; however, the present data could not be taken as a sufficient evidence for it, since $\Delta\sigma_{AgF} - \Delta\sigma_{Ag_2F} = 0.023$ is comparable with smallest Knight shift observed so far and the density of unpaired electrons at the fluorine nucleus of F^- would be expected to be rather small.

Microfilm \$2.00; Xerox \$5.00. 97 pages.

EXPLORATORY LIGHT SCATTERING AND VISCOSITY STUDIES OF POLYELECTROLYTES, POLYISOAPS, AND RELATED POLYMERS PREPARED FROM p-SULFONAMIDOSTYRENE AND p-n-ALKYLSTYRENES

(L. C. Card No. Mic 59-1813)

Jack Dickstein, Ph.D.
Rutgers University, 1959

Major Professor: Dr. Ulrich P. Strauss

Anionic polyelectrolytes and polysoaps containing the sulfonate group were prepared. The polysoaps were prepared by a copolymerization procedure using p-sulfonamidostyrene with either p-n-dodecylstyrene or p-n-octylstyrene and subsequent conversion to the sulfonic acid by the action of nitrous acid. The poly sodium and methylsulfonates were prepared from the sulfonic acids by the action of sodium hydroxide and diazomethane respectively. Reactivity ratio determinations for the monomers p-sulfonamidostyrene and p-n-octylstyrene were 11 ± 4 and 0 ± 0.07 respectively. This showed a strong preference of both radicals for the p-sulfonamidostyrene monomer. It was found that as much as 20 mole per cent p-n-octylstyrene could be incorporated

in a water-soluble sulfonic acid copolymer while as little as a few per cent p-dodecylstyrene failed to yield a completely water-soluble copolymer.

The hydrolysis of the sulfonamide forms of all the polymers to the sulfonic acids was incomplete. The action of nitrous acid yielded sulfonic acid polymers containing 5-10 per cent unhydrolyzed sulfonamide groups.

The decrease in reduced viscosity of aqueous solutions of sulfonic acid copolymers upon heating indicated that the solutions originally aggregated. A chemical reaction was shown to occur on the heating of solutions of the methylsulfonate form in solvents containing methyl ethyl ketone. This was detected by changes in light scattering turbidities and refractive increments. In contrast, the methylsulfonate form was stable on prolonged heating in isopropanol.

Molecular weight determinations on various derivatives of the polyelectrolyte and polysoap confirmed the good stability of these polymers both in the solid state and in a variety of solvents. The determination of the size of the polymer derivatives in various solvents gave good agreement by light scattering dissymmetry and viscosity measurements. Theta solvent dimensions were determined and shown to be dependent solely upon steric effects. One polymer series, prepared with the use of p-sulfonamidostyrene monomer stored for long periods, showed abnormally large theta solvent dimensions and unusual susceptibility to precipitation by salt. The suspected impurity in the original monomer was not detected by ultraviolet and infrared absorption spectra.

The comparison of the experimental results with some of the existing theories showed that those polar polymer derivatives devoid of octylstyrene follow the same theoretical relationships between molecular weight, intrinsic viscosity and second virial coefficient as have been observed for uncharged polymers.

The methylsulfonate containing 20 mole per cent octylstyrene showed second virial coefficient-size relationships not in accord with the usual empirical relationships. An explanation based on intramolecular attraction of the n-octyl groups was presented. The effect of electrolyte concentration on the size of the sodium sulfonate polyelectrolytes could not be correlated with theory.

Microfilm \$2.45; Xerox \$8.60. 187 pages.

THE RELATIVE STABILITIES OF THE ADDITION COMPOUNDS FORMED BY BORON TRIFLUORIDE AND THE ALIPHATIC NITRILES

(L. C. Card No. Mic 59-1979)

Eugene Stanley Domalski, Ph.D.
The University of Buffalo, 1959

Pressure-composition isotherms between aliphatic mono- and dinitriles, and boron trifluoride have been determined. The aliphatic mononitriles studied, formed one to one addition compounds with boron trifluoride, while in the dinitrile series, only malonitrile formed such a compound over the range of temperatures chosen for study. Cyanogen was not found to react with boron trifluoride, while succinonitrile, glutaronitrile and adiponitrile formed both mono- and dicoordinated addition compounds.

A study was also made of the variation of the dissocia-

tion pressure of the one to one addition compounds with temperature over a 50° temperature range. From these measurements, the equilibrium constant, the heat, free energy, and entropy of dissociation were calculated.

Microfilm \$2.00; Xerox \$6.80. 143 pages.

A THERMODYNAMIC STUDY OF SOME FACTORS AFFECTING THE STABILITY AND SOLUBILITY OF METAL CHELATES

(L. C. Card No. Mic 59-2396)

David Fleischer, Ph.D.
University of Pittsburgh, 1959

The heats of chelation for some metal chelates of 8-quinolinol, 2-methyl- and 4-methyl-8-quinolinol have been determined calorimetrically. Two generally applicable methods for calculating the calorimetric data were devised. One of these methods does not require a prior knowledge of the chelate stability constants.

The heats of chelation of the 8-quinolinol chelates were also calculated from the temperature dependence of the stability constants, which were determined by the Calvin-Bjerrum titration technique.

The three methods for determining the heats of chelation found in this work gave results that were in general agreement.

The thermodynamic quantities of chelation for 8-quinolinol and its methyl homologues were discussed in terms of reagent basicity, steric hindrance, entropies of hydration of the metal ions and the covalent and ionic radii of the metal ions.

The heats of neutralization of the reagents 8-quinolinol, 2-methyl- and 4-methyl-8-quinolinol were determined calorimetrically. The heats of neutralization of 8-quinolinol calculated from the temperature dependence of the ionization constants agreed with the calorimetrically determined values. The structural significance of these results was discussed.

The heats of reaction found in this work were generally not in agreement with those previously reported, as calculated from the temperature dependence of the equilibrium constants.

A study of the propagation of errors in the Calvin-Bjerrum technique, and in the calorimetric methods, has been used to evaluate the accuracy of these methods.

The solubilities of nickel(II)- and copper(II)-dimethylglyoxime were determined as functions of temperature in a series of solvents. The derived heats of solution were used to evaluate their difference in crystal energies. The data were discussed in terms of solvent basicity, relative acidity of the chelated metal atoms and a previously proposed nickel-to-nickel bond in the crystal state.

Microfilm \$2.00; Xerox \$7.20. 152 pages.

A STUDY OF THE THERMODYNAMICS AND
NUCLEAR MAGNETIC RELAXATION
TIMES OF ADSORBED GASES

(L. C. Card No. Mic 59-2397)

Ralph Jay Fries, Ph.D.
University of Pittsburgh, 1959

The purpose of this investigation was the study of the motional freedom of methane and ammonia adsorbed on a high surface area, nonporous, particulate silica. The thermodynamic properties of the adsorbed phase were calculated in the monolayer region from isotherm data obtained over a 20 degree temperature range. Both integral and differential molar heats and entropies of adsorption were calculated for methane at 138° K but the accuracy of the data was such that only the differential molar quantities at 298° K were calculated for ammonia. The spin-spin (T_2) and spin lattice (T_1) relaxation times were measured as a function of coverage for both adsorbates. In addition, T_1 and T_2 for methane and T_2 for ammonia were studied as a function of temperature at constant coverage.

The experimental entropy of the adsorbed phase was compared to that calculated from statistical thermodynamics for two assumed models, i.e.: (a) a two-dimensional gas whose molecules occupy a finite area and, (b) a set of localized, noninteracting oscillators. It was found that model (a) did not provide an adequate description of the adsorbed phase for methane or ammonia. The localized model, (b), on the other hand, was found to give a reasonable description of the adsorbed methane and also of the adsorbed ammonia if the rotation was hindered.

The relaxation times for both adsorbates were found to increase with increasing coverage and also with increasing temperature. T_2 was less than T_1 , by a factor of six for methane and by factors of 20 to 100 for ammonia. The relaxation time data were analysed by the Bloembergen, Purcell, and Pound (B.P.P.) theory, which indicated that intra-molecular (or rotational) dipolar interactions were predominant in the thermal relaxation process, and, further, that the data were obtained in a region where T_1 and T_2 should be equal.

The T_1 data for methane indicated that the rotation of the adsorbed molecules was hindered by a potential barrier of 350 to 1000 cal./mole. It is suggested that the inequality of T_1 and T_2 resulted in this case from line broadening caused by the complex geometry of the system and the bulk diamagnetic susceptibility of the solid silica.

The data for the coverage dependence of the relaxation times of adsorbed ammonia could be divided into a low (less than 0.6 of a monolayer) and a high coverage group. T_1 and T_2 increased linearly with coverage for each group, but the rate of increase for the high coverage group was six times greater than that for the low coverage group. A consideration of these data and also the unusual increase which occurred in the entropy of the adsorbed ammonia at about half a monolayer coverage led to the following picture of the ammonia-silica system. It was known that the silica surface was about 55 per cent covered with hydroxyl sites which adsorbed ammonia more strongly than the remainder of the surface. The ammonia adsorbed on the surface at low coverages forms hydrogen bonds with the hydroxyl sites, resulting in a relatively high barrier hindering the rotation of the adsorbed ammonia about the two axes "parallel" to the surface. As the surface concentra-

tion increases, the hydroxyl sites become completely covered and adsorption commences on the remainder of the surface. Since the ammonia cannot form strong hydrogen bonds with the nonhydroxyl surface, the rotational barrier for these molecules is much smaller than that encountered by the molecules on the hydroxyl sites. Therefore, as the hydroxyl sites become completely covered, there is an abrupt increase in the entropy and relaxation times of the adsorbed molecules.

The difference between T_1 and T_2 for adsorbed ammonia was more than could be accounted for by the bulk diamagnetic susceptibility calculations. The origin of the excess broadening, however, could not be ascertained from the data available.

Microfilm \$2.10; Xerox \$7.40. 160 pages.

ADSORPTION OF WATER VAPOR
ON SOME SOLID SURFACES

(L. C. Card No. Mic 59-2505)

Arthur Clifford Hall, Ph.D.
The University of Texas, 1958

Supervisor: Norman Hackerman

Adsorption of water vapor on powders of quartz silica, calcite, and kaolinite was investigated by a volumetric technique. Isotherms were obtained at 25°C. and 15°C. for silica and calcite, and at 25°C. for kaolinite. The effect of thermal recrystallization of quartz was studied by annealing a sample of quartz powder and comparing adsorption on the annealed and unannealed materials.

Adsorption isotherms for water on silica and calcite were of type II and from them were calculated the area per molecule of adsorbate on the adsorbent surface; the isosteric heats of adsorption; and the two-dimensional spreading pressures of the adsorbed films.

The two-dimensional spreading pressures of the adsorbed films; i.e., the free energies of adsorption, were derived from graphical integration of the Gibbs adsorption isotherm, and were used in turn to compute the free energy of immersion and the work of adhesion for each water-solid system.

Adsorption of polar substances on quartz is known to occur on a superficial layer of hydroxyl groups, each of which is bound to a silicon atom. For this reason care was taken to insure that the surface was fully hydrated, without the presence of physically adsorbed water molecules.

It was found that little, if any, sintering occurred on annealing for 48 hours at 700°C. but that the sample so treated exhibited increased adsorption of water vapor. The increase was attributed to an increase in the number of hydroxyl groups, and therefore of the number of silicon atoms in the surface. This hypothesis also correlated with the evidence provided by both the isosteric heats of adsorption, and calculated areas per adsorbate molecule on the adsorbent.

The free energies of immersion and work of adhesion values are fundamental thermodynamic quantities of great importance in studies of the wetting of solids.

Adsorption of water vapor on kaolinite was found to be irreversible, exhibiting adsorption hysteresis between

relative pressures of 0.4 and 0.85. The irreversibility precluded the calculation of thermodynamic quantities, but the pore radii were calculated from the Kelvin equation. It was also demonstrated by successive desorption and re-adsorption that the pore structure remained unaltered by the condensation of liquid in the pores of the kaolinite.

Microfilm \$2.00; Xerox \$5.20. 105 pages.

SPECTROPHOTOMETRIC STUDY OF SOME TRANSITION METAL COMPLEXES IN MOLTEN SALTS

(L. C. Card No. Mic 59-2445)

George W. Harrington, Ph.D.
New York University, 1959

Adviser: Associate Professor Benson R. Sundheim

Quantitative measurements were made of the absorption spectra of solutions of transition metal chlorides in molten LiCl-KCl eutectic. The spectra of cobalt(II), nickel(II) and chromium(III) thiocyanates in molten potassium thiocyanate were also investigated. The chromium(III) thiocyanate study was extended to include a spectroscopic study of a mixed pseudo-halogen complex of the type $\text{Cr}(\text{SCN})_m(\text{CN})_n^{3-(m+n)}$, where the sum of m plus n is always six.

The interpretation of the spectra was made on two bases: comparison to analogous spectra of crystals and solutions and application of the Ligand Field Theory.

The divalent transition metal ions were found to form four-fold tetrahedral or tetragonal complexes and the trivalent ions (except iron(III)) were found to form six-fold tetragonally distorted octahedral complexes. Iron(III) formed a four-fold chloro complex and not a six-fold complex.

Some of the four-fold complexes were found to have temperature dependent configurations. In the nickel chloride solution, for example, the form was tetragonal at low temperatures and tetrahedral at higher temperatures. A possible explanation for this behavior was proposed. It involved solvent influences and changes in crystal field environment.

Assignment of transitions and interpretation of intensities by means of the selection rules and appropriate energy level diagrams could be made satisfactorily in most cases.

Microfilm \$2.00; Xerox \$6.40. 132 pages.

THE CRYSTAL AND MOLECULAR STRUCTURE OF B_2Cl_6

(L. C. Card No. Mic 59-2356)

Robert Andrew Jacobson, Ph.D.
University of Minnesota, 1959

Unit cell dimensions and space groups of two modifications of B_2Cl_6 are described. Complete three-dimensional x-ray diffraction data of one of the modifications have been taken. The unit cell of this form is orthorhombic, of symmetry $P2_12_12_1$ and contains four B_2Cl_6 molecules in a unit cell of dimensions $a = 13.64$, $b = 7.85$ and $c = 12.91$ Å.

With only the information that boron and chlorine are present in the approximate ratio of ten to nine, the molecular structure of $\text{B}_{10}\text{Cl}_{18}$ has been determined. The chlorine positions, solved by a point-by-point, three-dimensional Patterson superposition method, enabled the boron atoms to be located from electron density maps. The boron atoms form a dodecahedron with triangular faces and D_{2d} symmetry. One chlorine atom is attached to each boron atom at an average distance of 1.70 Å. The shortest boron-boron distance is 1.78 Å. The overall agreement factor is

$$R = \frac{\sum |F_o| - |F_c|}{\sum |F_o|} = 0.17$$

Experience is summarized in the use of fractional shifts of scale, temperature and distance parameters, values of

$$r = \frac{\sum w(|F_o|^2 - |F_c|^2)}{\sum w|F_o|^4},$$

the behavior of temperature factors and a three-dimensional Patterson superposition program in the determination of a number of structures.

Microfilm \$2.00; Xerox \$3.00. 53 pages.

KINETIC STUDIES OF SOME ATOM AND FREE RADICALS (THERMAL DECOMPOSITION OF DIMETHYL ETHER)

(L. C. Card No. Mic 59-865)

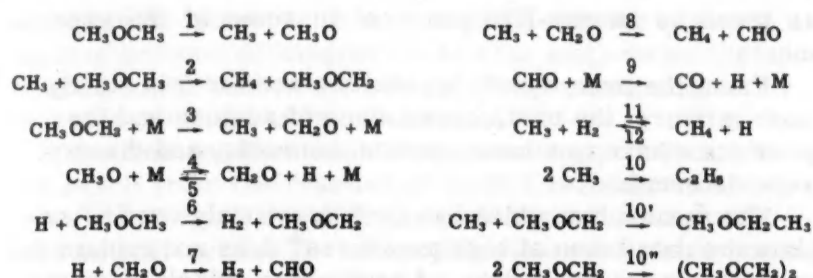
Dharam Vir Singh Jain, Ph.D.
University of Southern California, 1958

Chairman: Professor Sidney W. Benson

The importance of atomic and free radical reactions has been realized in the last twenty-five years. With our increased knowledge about these reactions, we now have a better understanding of combustion, catalyses, and photochemical processes. Thermal or photochemical decompositions involve a number of such reactions, and the importance of each in such decompositions is decided on the basis of the rate constant, concentration of reacting species, and many other factors. Such a system is very complicated, and the rate equation obtained by making use of the stationary state hypothesis is also very complex. Generally there is no way (or at least no easy way) of testing such equations, and consequently different mechanisms are suggested from time to time to explain the observed facts. Selection of correct mechanism is generally based on the fact that it explains all the observed facts satisfactorily under a very wide range of conditions (such as temperature, initial pressure, foreign gases, and different surfaces).

This dissertation is an exhaustive study of the decomposition of dimethyl ether. The pressure was varied from 30 to 400 mm, and the temperature ranged from 750° K to 825° K. The effect of foreign gases like hydrogen, nitrogen, methane, carbon monoxide, ethylene, and formaldehyde, as well as of different surfaces, has also been investigated.

It was found that the reaction initially is 3/2 order and is autocatalytic. This is also observed when hydrogen or formaldehyde is added separately. Inert gases have little effect on the rate constant. Ethylene is a strong inhibitor, suggesting that the decomposition is a chain reaction. The following modified Benson mechanism is proposed,



This mechanism, together with the stationary state hypothesis and reasonable assumptions, gives the following rate equation:

$$\frac{-d\text{Me}_2\text{O}}{dt} = \frac{k_2 \left(\frac{k_1}{k_{10}} \right)^{\frac{1}{2}} \text{Me}_2\text{O}^{\frac{3}{2}} \left[1 + \frac{\alpha \text{H}_2}{\text{Me}_2\text{O}} + \frac{\beta \text{CH}_2\text{O}}{\text{Me}_2\text{O}} \right]}{1 + \left(\frac{k_{10}'}{k_{10}} \right)^{\frac{1}{2}} \frac{k_2}{k_3} \left[\frac{\text{Me}_2\text{O} + \alpha \text{H}_2 + \beta \text{CH}_2\text{O}}{\text{M}} \right]}$$

At the start of the reaction ($t = 0$) this reduces to a simple 3/2 order equation:

$$\frac{-d\text{Me}_2\text{O}}{dt} = \frac{k_2 \left(\frac{k_1}{k_{10}} \right)^{\frac{1}{2}} \text{Me}_2\text{O}^{\frac{3}{2}}}{1 + \left(\frac{k_{10}'}{k_{10}} \right)^{\frac{1}{2}} \left(\frac{k_2}{k_3} \right)}$$

From this equation the value of $\frac{k_2 \left(\frac{k_1}{k_{10}} \right)^{\frac{1}{2}}}{1 + \left(\frac{k_{10}'}{k_{10}} \right)^{\frac{1}{2}} \left(\frac{k_2}{k_3} \right)}$ is

found, and from the known values of k_2 and k_{10} the values of other constants are determined. The activation energy for the overall reaction is 54.8 Kcal, and that estimated from $RT^2 \frac{d \log \left(\frac{k_2 \left(\frac{k_1}{k_{10}} \right)^{\frac{1}{2}}}{1 + \left(\frac{k_{10}'}{k_{10}} \right)^{\frac{1}{2}} \frac{k_2}{k_3}} \right)}{dT}$ is 54.9 Kcal, in close agreement with the experimental value.

Microfilm \$2.00; Xerox \$4.20. 77 pages.

EXPLORATORY STUDIES ON THE SURFACE ACTIVITY OF POLYSOAPS

(L. C. Card No. Mic 59-1817)

Helmuth Erik M. Jorgensen, Ph.D.
Rutgers University, 1959

Major Professor: Ulrich P. Strauss

The surface activity of several polysoaps was studied at air-water and water-hydrocarbon interfaces, both in the absence and presence of simple electrolyte. Among the materials studied were several polysoaps and one polyelectrolyte derived from poly-4-vinylpyridine, a sulfonic acid polysoap, and a polysoap derived from poly-2-vinylpyridine.

Four of the polysoaps were prepared by quaternizing 9.5%, 20.3%, 35.0%, and 46.5% of the nitrogens of low-molecular weight poly-4-vinylpyridine with n-dodecyl bromide and the remainder with ethyl bromide. These poly-

soaps, together with polysoap G 147, which had been prepared by Gershfeld (33) in a similar manner from a higher-molecular-weight poly-4-vinylpyridine sample with 13.6% n-dodecyl quaternization, were compared by surface-tension measurements in both aqueous and KBr-water solutions. The results obtained show that: -

1. In the absence of KBr there is very little effect of added polysoap upon the surface tensions of the solutions.
2. In the presence of KBr the polysoaps decrease the surface tension markedly although much less than do ordinary soaps. The surface excess of polysoap in moles per cm^2 was calculated and showed that the polysoap was positively adsorbed at the surface.
3. The polyelectrolyte, prepared by quaternizing all the nitrogens of poly-4-vinylpyridine with ethyl bromide, had essentially no effect upon the surface tension even in the presence of KBr.
4. Equilibrium was reached rapidly indicating very little, if any, change in polysoap configuration during adsorption.

5. The molecular weight of the polysoaps had no noticeable effect upon the surface tension, and the surface excess in moles per cm^2 was independent of molecular weight.

6. The amount of n-dodecyl bromide quaternization also seemed to have no effect upon the surface tension.

Interfacial tensions of the polysoaps, in both aqueous and KBr-water solutions, were measured against n-heptane and benzene. In all cases, the depression of the interfacial tension was slightly larger than the depression of the surface tension. However, the differences could easily be accounted for by the presence of solubilized hydrocarbon when measuring the interfacial tension. This was demonstrated by showing that the surface tension of the polysoap solutions was significantly depressed by solubilized hydrocarbon.

The small effect of the polysoap upon the surface and interfacial tensions in the absence of simple electrolyte, allows one to speculate that in water, micelles of ordinary soap or detergent molecules are not significantly adsorbed at air-water or hydrocarbon-water interfaces.

The sulfonic acid polysoap, which was a copolymer of 20 mole % octyl styrene and 80 mole % styrene sulfonic acid and its sodium salt, acted like the polyelectrolyte in that they had very little effect upon the surface tension even in the presence of simple electrolyte.

The surface-tension effects of polysoap A 1-144, made by Ammondson (36) by quaternizing 39.4% of the nitrogens of poly-2-vinylpyridine with 3-bromopropylbenzene, were measured only in the absence of KBr, since the polysoap was precipitated by the addition of electrolyte. In contrast to the other materials studied, this polysoap depressed the surface tension significantly and also showed definite time effects. In some cases, up to twelve hours were needed for equilibrium to be reached. The time effects are probably due to a change in configuration as the polysoap molecules are adsorbed at the air-liquid interface. Measurements at different temperatures showed that the rate of adsorption of polysoap A 1-144 increased and that the surface tension decreased with an increase in temperature.

Microfilm \$2.00; Xerox \$5.20. 102 pages.

THE PHOTOCHEMICAL DECOMPOSITION OF ACETONE AT LOW PRESSURES

(L. C. Card No. Mic 59-2293)

Robert Orland Leach, Ph.D.
The Ohio State University, 1953

The photochemical decomposition of acetone has been extensively studied. Several excellent reviews of the previous work are available.^{1,2,3}

The products of the room temperature photolysis of acetone are ethane, CO, diacetyl, and methane. The relative amounts of these substances produced depend upon the pressure, the light intensity, and the temperature. As the temperature is raised, the amount of diacetyl produced decreases while the yield of methane increases. Under conditions of very low light intensity and pressures above 150 mm., the room temperature yield of methane may exceed that of ethane,⁴ although with the light intensities and pressures most frequently employed, methane is formed only in trace amounts at room temperature.

The free radical nature of the reaction at all wave lengths from 3130 to beyond 2000 Å. is now generally accepted.

Previous study of the acetone photolysis has been limited to pressures exceeding 10 mm. In the present work, a technique for studying photochemical reactions at pressures of less than 0.1 mm. has been developed. By means of it the room temperature photochemical decomposition of acetone has been studied in the pressure range from 0.003 to 0.1 mm.

The measurements were made using a flowing system in which acetone vapor supplied by a large reservoir flows through an irradiation chamber of 40 cm. path length and 0.6 liter volume, and into the source of a mass spectrometer. The flow characteristics of the system are such that, in the pressure range studied, the flow rate from the irradiation chamber was approximately 10^{-3} liters sec.⁻¹. Molecular flow equations describe the gas flow in the system.

The AH-6 high pressure mercury arc lamp and a suitable filter provide a high incident light intensity in the band of wave lengths from 3400 to 2400 Å. Approximately 10^{18} quanta sec.⁻¹ in the absorption region of acetone were incident upon the irradiation chamber.

The mass spectrometer was designed and constructed for this investigation. High gas-handling capacity is provided by use of three separate pumping lines, each having a minimum diameter of two inches. Each pumping line is exhausted by a large cold trap and DPI GHG-15-01 three-stage mercury diffusion pump.

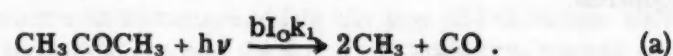
The experiments were carried out in the following manner. Acetone vapor was caused to flow from a reservoir through a capillary leak into the irradiation chamber. After one hour a steady-state pressure was attained in the irradiation chamber, at which pressure the acetone was flowing out of the irradiation chamber and into the mass spectrometer source at the same rate it entered from the reservoir. The mass spectrogram for pure acetone was obtained after this steady-state pressure was reached. The light was then turned on. After one hour of illumination a steady-state gas mixture was attained in the irradiation chamber, in which the acetone partial pressure was lower than its value under "light off" conditions. The light intensity and flow rates were such that the acetone pressure was lowered

as much as twenty-five per cent in some of the experiments.

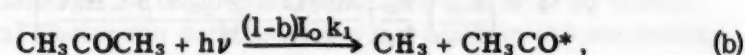
From the mass spectrogram obtained for this steady-state mixture, the partial pressures of acetone and the products ethane, methane, carbon monoxide, and diacetyl were determined.

The mechanism which has been previously used to explain the data taken at high pressures² does not explain the present low pressure data. A mechanism which is consistent with both high and low pressure data follows.

A fraction, b , of the decomposing acetone molecules undergo the primary process:

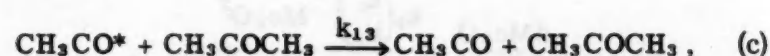


The largest fraction of the decomposition occurs by the process

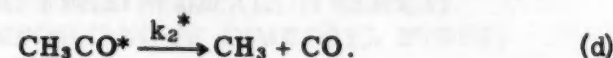


where CH_3CO^* is an acetyl radical in some excited state.

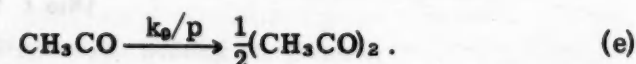
This excited acetyl radical is subject to collisional deactivation,



and is also subject to the homogeneous decomposition



The "unexcited" acetyl radicals produced by reaction (c) diffuse rapidly to the walls to form diacetyl,^{1,2} according to

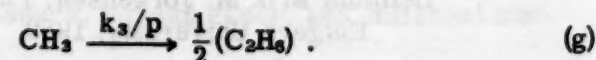


The homogeneous reaction

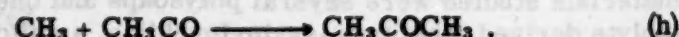


is too slow to be of importance under the present very low pressure conditions. However, at high pressures² (greater than ten mm.) it accounts for substantially all of the acetyl radical decomposition. Under such conditions process (c) occurs very rapidly while process (e) is, of course, much slower than it is at very low pressures.

Ethane is formed by the combination of two methyl radicals. It may not be decided from the ethane data obtained in this work whether this is a first order wall reaction or a homogeneous bimolecular reaction. However, because of the very high diffusion rates under the present conditions, and because methyl radicals were not detected in the products, the reaction is considered to occur at the walls^{1,2} according to



Previous workers have found that the room temperature quantum yield of decomposition of acetone is less than unity. This fact has been explained^{1,2} in terms of a recombination of the products of the primary process to form acetone, according to the reaction



This reaction is shown by the present data to be unimportant for very low pressures. It was not feasible in the present work to measure directly the amount of light absorbed. Therefore, no absolute quantum yields were

determined. However, it seems likely that the quantum yield of acetone decomposition is near unity under the present low pressure conditions, since reaction (h) under these circumstances is unimportant.

The methane formed in the present experiments does not result from the reaction of methyl radicals with acetone,⁴ nor does it result from a reaction of methyl radicals with diacetyl. The assumption that methane formation is a wall reaction gives the best agreement between theory and data. It appears probable, however, that there is more than one mode of methane formation.

On the basis of fluorescence study using 3130 Å radiation, Groh, Luckey and Noyes⁵ propose that substantially all of the decomposition occurs from one of the fluorescing states of acetone. This mechanism for the primary process is not in agreement with the present data. However, most of the light absorption in the present experiments occurs at around 2700-2800 Å, and these wave lengths excite the fluorescence of acetone only very weakly. The present data therefore do not deny the correctness of the Groh, Luckey and Noyes mechanism for the reaction at 3130 Å. It is believed that low pressure experiments using monochromatic 3130 Å radiation would provide a suitable test. Microfilm \$2.00; Xerox \$5.40. 108 pages.

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- Abstract published by special arrangement with The Ohio State University.

THE SPECTRUM AND STRUCTURE OF THE ALUMINUM MONOSULFIDE MOLECULE

(L. C. Card No. Mic 59-1875)

Charles Nash McKinney, Ph.D.
Vanderbilt University, 1959

Supervisor: Professor K. Keith Innes

A graphite tube resistance furnace was used to search for new spectra of diatomic molecules containing aluminum. The furnace was constructed so that it could be heated rapidly from room temperature to any desired temperature up to 2000 °C under the full range of reduced pressures. A new red-degraded band system was observed in the region 3700 to 4800 Å when aluminum, sulfur and argon were heated to 1800 °C in the furnace.

Spectrograms of the bands were made in the second order of a 3.4 meter Jaco-Ebert Spectrograph equipped

with a 150,000 line Bausch and Lomb plane grating. The dispersion was 1 Å/mm. and the resolving power actually obtained was 150,000. Lines of the 3-0, 2-0, 1-0, 0-0, 0-1, and 0-2 bands were measured with a David W. Mann 200 mm. Comparator.

The band system showed single heads that formed two strong progressions with the 0-0 band at their intersection. The band head frequencies (cm.⁻¹) were found to be represented by the formula

$$\nu - 2.5 = 23381.16 - 613.79\nu'' + 3.33\nu''^2 + 509.46\nu' - 1.45\nu'^2.$$

The bands have P and R branches which are split into doublets at a small distance from the band head characteristic of a $^2\Sigma - ^2\Sigma$ transition. Rotational analysis of the bands yielded the following constants,

	T_e	ω_e	$\omega_e x_e$	B_e	α_e
A	23433.79	510.91	1.45	.2461	.0012
X	0	617.12	3.33	.2799	.0018

Where X indicates the ground state and A the excited state, T_e their energy separation, ω_e the equilibrium vibrational frequencies, $\omega_e x_e$ the anharmonicity constants, B_e the rotational constants, and α_e the value that expresses the variation of B_e with vibrational quantum number. In addition, spin splitting constants were determined for the 2-0, 0-0, 0-1, and 0-2 bands.

From the B_e value of the lower state the bond distance was found to be 2.029 Å. The force constant was found to be 3.283×10^5 dynes cm.⁻¹ using the ω_e value of the ground state.

It was determined that the lower $^2\Sigma$ state is the ground state of AlS with an electron configuration of $KKLL(\sigma 3s_A)^2(\sigma 3s_B)^2(\pi 3p_A)^4(\sigma 3p_A)$. The fact that the ground state was observed allowed the estimation of the dissociation energy from ω_e'' and $\omega_e'' x_e''$ to be 3.1 electron volts.

Microfilm \$2.00; Xerox \$5.40. 109 pages.

CAPACITY OF SOLID METAL-SOLUTION INTERPHASES

(L. C. Card No. Mic 59-2503)

James Joseph McMullen, Ph.D.
The University of Texas, 1957

Supervisor: Dr. Norman Hackerman

An electric analog circuit for a metal-solution interphase was assumed. The potential-time changes occurring across this circuit when a square wave voltage is applied were derived mathematically. The results of this analysis were verified by means of cathode-ray oscilloscope traces using an actual circuit and various values of the components. It was demonstrated that the capacitive component could be simply measured.

The same method was used to determine the capacities of the following interphases: mercury - 0.1 N Na_2SO_4 , platinum - 1 N Na_2SO_4 , silver - 1 N Na_2SO_4 , copper - 1 N Na_2SO_4 , aluminum - 1 N Na_2SO_4 and tantalum - 1 N Na_2SO_4 . Capacity-potential curves for these interphases are shown and interpretations of the observed results are given.

Microfilm \$2.00; Xerox \$4.20. 76 pages.

CAPACITY OF THE ELECTRICAL DOUBLE LAYER AND ADSORPTION AT POLARIZED PLATINUM ELECTRODES

(L. C. Card No. Mic 59-2507)

Pranjivan Velji Popat, Ph.D.
The University of Texas, 1958

Supervisor: Dr. Norman Hackerman

The differential capacity of the electrical double layer at polarized platinum electrodes as a function of the type and concentration of various anions has been investigated by the method of charging curves utilizing a square-wave signal. An interpretation is advanced for the potential-capacity curve for each anion. The hump in the potential-capacity curve is found to be a characteristic function of the anion involved and is explained in terms of adsorption or desorption of the anion. The tenacity with which each anion is held at the electrode is found to be proportional to the degree of covalent character of the adsorbed anion and follows this order: I^- Br^- Cl^- SO_4^{--} F^- and NO_3^- . Evidence is presented to show that the adsorbed iodide, bromide, and chloride ions are probably dehydrated before their anodic discharge whereas the fluoride and nitrate ions are not dehydrated to any significant degree. The effect of anion concentration and temperature on the hump has been interpreted on the basis of adsorption. Also, the effect of chemisorbed anions on the overvoltage of hydrogen evolution on platinum has been qualitatively explained in terms of the covalent character of each anion.

Some experimental evidence is presented to suggest that different cations, while occupying the double layer, are probably solvated to different degrees.

A similarity is established between polarized platinum and mercury electrodes and the most probable region of the point of zero charge for platinum is indicated.

A preliminary study of the adsorption-desorption process of inorganic and organic neutral molecules is included. Inorganic neutral molecules are found to behave the same way as organic ones.

Microfilm \$2.00; Xerox \$6.00. 121 pages.

THE IMPEDANCE AT POLARIZED PLATINUM ELECTRODES IN VARIOUS ELECTROLYTES

(L. C. Card No. Mic 59-948)

Manfred Joseph Prager, Ph.D.
New York University, 1956

Adviser: S. N. Sarmousakis

The electrical impedance at platinum electrodes in contact with molar potassium chloride, potassium bromide and potassium iodide solutions has been determined. Platinum electrodes were combined with reversible electrodes to form cells, which were then polarized at various direct current potentials. The impedances of the cells, placed in one arm of an alternating current bridge, were then measured, employing a small alternating potential to activate the bridge. The effect of the variation of electrode potential, nature of electrolyte, area of electrode and frequency of alternating current was determined.

The capacity was found to be directly proportional to the surface area of the electrode. For all electrolytes used the capacity was relatively high at the most negative potentials used, decreased as the potential was made more positive, passed through a minimum and increased again at more positive potentials. The high capacity at extremely negative potentials is presumably associated with the discharge of hydrogen ions and the ionization of hydrogen from a layer adsorbed on the metal surface together with changes of the double layer at the interface. At intermediate potentials where no reactions occurs changes of the double layer determine the capacity. The capacity at extremely positive potentials is attributed to discharge of halide ions and ionization of halogen as well as changes of the double layer at the interface.

The measured capacity was found to be proportional to the reciprocal of the square root of the frequency, within experimental error, at frequencies of about 1000 cycles per second and greater. By extrapolating the capacities to infinite frequency the double layer capacities were obtained and the series capacity and series resistance presumably due to the faradaic admittance were calculated. This series capacity is proportional to the reciprocal of the square root of the frequency, within experimental error, at frequencies of about 1000 cycles per second and greater. The series resistance is roughly proportional to the reciprocal of the frequency at frequencies of about 1000 cycles per second or greater. The observed frequency effect is unlike that required, according to proposed theories, for fast or slow reversible, diffusion controlled electrode reactions. The frequency effect may be due, largely, to lack of symmetry between the electrodes and roughness of the surface of the microelectrodes.

Microfilm \$2.00; Xerox \$5.00. 97 pages.

MEASUREMENT OF TEMPERATURE COEFFICIENTS IN AQUEOUS SYSTEMS UP TO 200°C USING PACKED COLUMN TECHNIQUES

(L. C. Card No. Mic 59-1877)

Richard Jay Raridon, Ph.D.
Vanderbilt University, 1959

Supervisor: Dr. Kurt A. Kraus

The temperature dependence of several types of chemical equilibria was measured in the temperature range 2 to 200°C. These included ion exchange equilibria, acid adsorption by hydrous oxides, and the solubility of silver chloride. Packed column techniques were employed and pressurized equipment was used for measurements above the boiling point of the solution. Radioactive tracers were employed whenever possible to facilitate the analytical procedure.

A. Ion Exchange Equilibria

The adsorption of metal ions at trace concentrations by the organic exchangers Dowex-50 and Dowex-1 was studied as a function of temperature, from 2 to 200°C. The metal ion, in the form of a radioactive tracer, was uniformly adsorbed on the resin, which was then placed in a column and eluted with a solution of known concentration.

Ten different cation exchange reactions were studied using Dowex-50 in the hydrogen form, and four with Dowex-50 in the sodium form. The ions included alkali metals (Na^+ , K^+ , Rb^+ , and Cs^+), alkaline earths (Be^{++} and Ba^{++}), transition elements (Co^{++} and Zn^{++}), and rare earths (La^{+3} and Eu^{+3}). The adsorption of Br^- by Dowex-1 (anion exchanger) in the chloride form was also studied. All measurements were made at constant ionic strength. The effect of temperature was small; the greatest change in adsorption found was a tenfold increase, for a temperature change of 140° . Above 150°C there were indications that the hydrogen form of Dowex-50 was undergoing some change, probably desulfonation, while the sodium form appeared to be stable to 200° . Dowex-1 in the chloride form also underwent some change above 150° .

Plots of $\log K'$ (K' is the selectivity coefficient) vs. $(1/T)$ (T is the absolute temperature) for all the exchange reactions studied showed definite curvature, concave upward, thus indicating that the heat capacity changes were not zero. An empirical equation was used to fit the data and this equation was differentiated to calculate apparent enthalpy $\Delta H'$, entropy $\Delta S'$, and heat capacity $\Delta C_p'$ changes. Values of $\Delta C_p'$ ranged from 1.5 to 20.5 cal/equiv. Values of $\Delta H'$ and $\Delta S'$ increased with increasing temperature, since $\Delta C_p'$ was positive for each system studied. Values of $\Delta H'$ ranged from -4 to +4 kcal/equiv, the greatest change being 4 kcal from 0 to 200°C . Values of $\Delta S'$ ranged from -10 to +15 e.u., the greatest change being 10 e.u. from 0 to 200°C .

The metal-chloride complexes of Zn(II) and Ga(III) were studied as a function of temperature (25 to 150°C) and HCl concentration, using anion exchange techniques (trace metal adsorption on Dowex-1). The adsorbability of both elements decreased with increasing temperature at high HCl concentrations and increased with increasing temperature at low HCl concentrations. Both elements exhibited adsorption maxima, the values of which decreased with increasing temperature, while the position of the maxima shifted to lower HCl concentrations. There was evidence for the existence of intermediate complexes of Zn(II) at elevated temperatures, while the main species at 25°C were probably Zn^{++} and ZnCl_2^- . Ga(III) appeared to form principally GaCl_4^- at all temperatures studied, but there was evidence that greater amounts of intermediate complexes were present at elevated temperatures.

B. Adsorption of Nitric Acid by Hydrous Oxides

Apparent heats of adsorption of nitric acid by hydrous oxides of Zr(IV) , Ti(IV) , Sn(IV) , and Nb(V) were measured for the temperature range 25 to 200°C . Measurements were made at constant loading of the oxide. Analyses were carried out with a small conductivity flow cell, through which the effluent from a column bed of oxide passed. The heats of adsorption were fairly constant for each oxide at all temperatures studied. The values found per mole of HNO_3 were -8.2 kcal for Zr(IV) , -2.0 kcal for Sn(IV) , -2.4 kcal for Ti(IV) , and -2.6 kcal for Nb(V) .

C. Solubility of Silver Chloride

The feasibility of using column techniques for solubility measurements at high temperatures in pressurized systems was investigated. The apparatus used employed a built-in scintillation counter to analyze the effluent from a bed of

precipitate while the effluent was still at the same temperature as the column. In this manner, errors in the analyses caused by crystallization of the saturated solution were satisfactorily avoided.

The solubility of AgCl (precipitated from a solution containing Ag^{110} tracer) was measured from 25 to 200°C in HCl concentrations ranging from 0.01 to 3.06 m (molality). The increase in solubility s with increasing temperature was ca. sixtyfold for $m_{\text{HCl}} = 3.06$ from 25 to 200°C , and ca. seventeen hundredfold for $m_{\text{HCl}} = 0.01$ for the same temperature range. Plots of $\log s$ vs. $(1/T)$ (T is the absolute temperature) at constant m_{HCl} gave fairly linear relationships, indicating that the apparent heats of solution were constant. Values of the heat per mole of AgCl ranged from 6.5 kcal for $m_{\text{HCl}} = 3.06$ to 11.9 kcal for $m_{\text{HCl}} = 0.01$.

Microfilm \$2.00; Xerox \$5.40. 107 pages.

REACTION OF ISOPROPYL ALCOHOL OVER THORIUM OXIDE CATALYSTS

(L. C. Card No. Mic 59-1730)

Paul G. Schmidt, Ph.D.
The University of Florida, 1959

The decomposition of isopropyl alcohol has been studied in order to determine the effect of pretreatment on the catalytic activity and surface structure of the thorium oxide.

From 380° to 420° , isopropyl alcohol decomposes by a dehydration-type reaction and a dehydrogenation-type reaction. Dehydration produces propylene and water, while dehydrogenation produces acetone and hydrogen. Dehydration was found to be faster than dehydrogenation by a factor of the order of ten.

Thorium oxide catalysts were prepared by precipitating thorium nitrate with ammonia and activating in a vacuum for five hours at 500° , 600° , 700° , or 800° . The catalysts activated at 600° and 700° were made into pellets under a pressure of 5000 pounds per square inch.

At a given reaction temperature, the amount of dehydration and the amount of dehydrogenation were found to decrease with increasing temperature of catalyst activation. The ratio of the amounts of dehydration to dehydrogenation, however, was found to increase. For a given catalyst, the amounts of dehydration and dehydrogenation increased with temperature only for those catalysts that were not pelleted. With pelleted catalysts, the amount of dehydrogenation increased with increasing temperature of reaction, but the amount of dehydration fluctuated.

The dehydration reaction over the non-pelleted catalysts activated at 700° was found to be a zero-order reaction. The energy of activation was found to be 1.4 kcal/mole. The apparent energies of activation for the dehydrogenation reactions were determined at the reciprocal space velocity of 5.35, and were found to be 9.5, 7.8, and 6.9 kcal./mole for the catalysts activated at 600° , 700° , and 800° , respectively.

X-ray diffraction patterns were obtained for the activated thorium and the average crystallite size of the particles was found to increase with increasing temperature of activation. The size was also greater after the thorium was used as a catalyst than before use. The average crystallite

size of the thoria particles could not be directly related to the catalytic activity.

From these experimental observations it has been deduced that the number of active sites for dehydration and dehydrogenation and the surface area of the thorium oxide catalysts decreases with increasing temperature of activation. Also, the dehydration reaction appears to be taking place in the pores of the catalyst, while the dehydrogenation reaction appears to be taking place on the external surface. This, then, would indicate that the ratio of intrapore surface to outer surface increases with increasing temperature of activation. It has also been deduced that at the higher activation temperatures there are fewer active sites for dehydrogenation, but the sites are of higher energy. Microfilm \$2.00; Xerox \$4.20. 77 pages.

THE DILUTE SOLUTION PROPERTIES AND THE STRUCTURE OF CRYSTALLINE POLY(PROPYLENE OXIDE)

(L. C. Card No. Mic 59-2272)

Charles Shambelan, Ph.D.
University of Pennsylvania, 1959

Supervisor: Robert E. Hughes

A general study of the dilute solution properties and of the x-ray structure of crystalline poly(propylene oxide) was conducted.

The crystalline polymer was prepared by the polymerization of racemic monomer with a ferric chloride-propylene oxide complex catalyst.

The solubility of the polymer was determined in a broad solvent spectrum. The cohesive energy density of the polymer was found to be between 9.3 and 10 in poor hydrogen bonding solvents, about 9.9 in medium hydrogen bonding solvents, and considerably higher in good hydrogen bonding solvents.

Fractional precipitation of the polymer from an isopropanol-water system provided ten fairly sharp fractions for molecular weight studies. The fractionation was conducted at 70°C. in order to assure liquid-liquid phase separation.

Solutions of the various fractions were studied by light scattering, osmometry, and viscosity techniques in benzene and o-dichlorobenzene at 25°C. Refractive index increments were determined in a Rayleigh-Haber-Lowe Interferometer. The weight average molecular weights (\bar{M}_w) ranged from 23,700 to 396,000. The weight to number average molecular weight ratios obtained for the various fractions showed the fractions to be quite sharp. The molecular weights were correlated with intrinsic viscosity results to establish the following viscosity-molecular weight relationships:

for benzene at 25.00°C.

$$\eta = 0.810 \times 10^{-4} \bar{M}_w^{0.85}$$

$$\eta = 0.92 \times 10^{-4} \bar{M}_n^{0.85}$$

and for o-dichlorobenzene at 25.00°C.

$$\eta = 2.14 \times 10^{-4} \bar{M}_w^{0.75}$$

$$\eta = 2.38 \times 10^{-4} \bar{M}_n^{0.75}$$

The root mean square end to end lengths for the higher molecular weight fractions were determined from dissymmetry data. Values for the Flory Universal Parameter, Φ , were calculated to be 2.17×10^{21} and 2.01×10^{21} for the highest molecular weight fraction in benzene and o-dichlorobenzene respectively.

The molecular weight distribution was also calculated and was qualitatively compared with the distribution expected from the proposed polymerization mechanism.

The crystal structure of the poly(propylene oxide) was determined by an x-ray diffraction study of oriented fibers extruded from the melt. The analysis of 57 independent reflections yielded the unit cell dimensions and the space group selections possible for this data.

The unit cell is orthorhombic with $a = 10.52$, $b = 4.68$ and $c = 7.10$ Å. The two possible space groups, $Pna2_1$ and $P2_12_12_1$ introduce an ambiguity into the structure in that one requires internal enantiomorphism while the other does not. Either description can be approximated with only slight structural disorder by assuming random mixtures and d and l molecules.

A trans zig-zag chain conformation was proposed, as was the disposition of these chains in the unit cell. The calculated diffraction intensities based on the proposed structure were found to be in reasonable agreement with experimentally observed intensities.

A fourier analysis of the data was carried out, and an electron density plot of the c -projection of the unit cell was constructed. A detailed consideration of the possible structural conformations for this polymer was made, and one was found to be consistent with the observed x-ray data. The isotactic nature of the crystalline polymer was proven in this analysis.

Microfilm \$2.10; Xerox \$7.40. 160 pages.

THE LUMINESCENCE AND CHEMISTRY OF EXCITED ELECTRONIC STATES OF ACRIFLAVINE

(L. C. Card No. Mic 59-2407)

Donald James Shombert, Ph.D.
University of Pittsburgh, 1959

A study was made of the long-lived luminescence from the triplet state of dye molecules adsorbed on silica gel. The chemiluminescent reaction between dye triplets and oxygen reported by Kautsky and Müller (1) was also studied in detail.

The decay rate of phosphorescence of acriflavine was studied from -196°C. to +40°C. for both the alpha and beta bands. It was shown that the observed rate is affected by dye concentration and depends on the wave length of excitation and observation. The rates for the alpha and beta bands were shown to be the same at any temperature. The decay is not exponential and the shape of the decay curve is not affected by triplet concentration. It must therefore be a sum of first-order processes, presumably due to triplet states of dye molecules which are differently bonded to the silica surface.

The activation energy from triplet to excited singlet was determined to be 8.2 kcal. It was shown that there is an activation energy of about 5 kcal for crossing from excited singlet to triplet, so that the crossing point between

the states is not exclusively at the lowest vibrational level of the excited singlet. The nonradiative decay from triplet to ground at low temperatures was shown to be in the same order of magnitude as the radiative decay.

The interaction between dye triplets and oxygen was studied over a wide range of conditions. The mechanism was shown to be:

- (1) $T + O_2 \rightleftharpoons T \cdot O_2 \longrightarrow S + O_2^*$
- (2) $T + O_2^* \longrightarrow \text{Oxid. Prod.} + h\nu_{\text{chemiluminescence}}$
- (3) $O_2^* \xrightarrow{\text{surface}} O_2$

Reaction (1) reduces to (4) except at very low temperatures:

- (4) $T + O_2 \longrightarrow S + O_2^*$

The experimentally determined activation energy and the frequency factor for process (1) at very low temperatures are in good agreement with those for desorption of oxygen from silica.

Reaction (1) or (4) results in quenching of the beta phosphorescence. It was shown that at least one in every ten or twenty collisions is effective for quenching above about -160°C . Except at very low temperatures, quenching is essentially independent of temperature. Quenching of the beta phosphorescence was shown to be first order in triplets.

The quantum yield of chemiluminescence does not exceed a few per cent under any conditions, and is between first and second order in triplets. It is essentially independent of temperature above about -160°C . The spectrum of chemiluminescence is not the same as that of alpha phosphorescence of acriflavine, but is shifted 20 to 30 $m\mu$ towards the blue.

Oxygen is consumed in the chemiluminescent reaction. Oxygen consumption is between first and second order in triplets and the quantum yields for oxygen consumption and chemiluminescence are in the same order of magnitude. Almost complete quenching can be observed under conditions such that chemiluminescence and oxygen consumption are negligible. If acriflavine is subjected to prolonged photo-oxidation, the absorption spectrum of the products has a maximum about 30 $m\mu$ farther towards the blue than the absorption maximum of acriflavine.

Both the quenching and the chemiluminescence were observed for proflavine adsorbed on silica and for fluorescein adsorbed on alumina. The general kinetics are the same as for acriflavine adsorbed on silica.

Reference

1. H. Kautsky and G. O. Müller, *Z. Naturforsch* 2a, 167 (1947). Microfilm \$2.15; Xerox \$7.60. 161 pages.

ADSORPTION AND DIFFUSION OF HYDROGEN IN THORIUM

(L. C. Card No. Mic 59-2426)

Donald Gilbert Westlake, Ph.D.
Iowa State College, 1959

Supervisors: Daniel Peterson and Charles A. Goetz

The absorption rate of hydrogen by thorium has been studied at temperatures between 350 and 700°C and pressures up to 400 mm of mercury. Absorption followed the parabolic rate law. Below 550°C , the log of the absorption rate varied linearly with the reciprocal of the absolute temperature making it possible to estimate the energy of activation for diffusion of hydrogen in thorium dihydride to be 19.6 kcal. The absorption rate showed no pressure dependence below 450°C . At higher temperatures, the absorption rate increased with increasing pressure. This pressure dependency became more pronounced with increased temperature. Differences in the purity level and the microstructure of the thorium metal had only minor effects on the absorption rate.

The diffusivity of hydrogen in thorium was determined at temperatures between 600 and 900°C by measuring the evolution rate of hydrogen from thorium cylinders. The value of D found at a given temperature was dependent on the initial hydrogen concentration of the cylinder. At 600°C , the diffusivity decreased with increasing initial concentration, while the opposite concentration dependence was observed at and above 700°C . The diffusivities obtained by extrapolation to zero concentration were plotted against $1/T$. The linearity of this plot indicated that the temperature dependence of the diffusivity of hydrogen in thorium satisfies an Arrhenius equation, where D_0 is $2.92 \times 10^{-3} \text{ cm}^2/\text{sec}$ and the energy of activation for diffusion of hydrogen in thorium is 9.75 kcal/g atom. The evolution rate varied nearly inversely with the square of the radius of the sample which indicated that the rate controlling step was diffusion. Had some surface reaction been controlling, the evolution rate would have varied nearly inversely with the radius.

Between 300 and 600°C , the diffusivity of hydrogen in thorium was determined by measuring the radial concentration gradient in a long thorium cylinder after hydrogen had diffused into it from a thorium dihydride surface layer. Since only the gradient within the metal was considered, no interface reactions could have affected the results. The data obtained in this manner, plotted as $\log D$ vs $1/T$ fell on the same straight line as the evolution data. Differences in microstructure and the purity level of the thorium had little effect on the hydrogen diffusion rate.

Microfilm \$2.00; Xerox \$3.00. 59 pages.

ECONOMICS

ECONOMICS, GENERAL

THE DEFINITION AND MEASUREMENT OF THE TRAVEL AND VACATION INDUSTRY

(L. C. Card No. Mic 59-2224)

Francis Earl Brown, Jr., Ph.D.
University of Pennsylvania, 1959

Supervisor: J. Parker Bursk

This study attempts to define the Travel and Vacation Industry and to develop a method for measuring that Industry. The definition, in general terms, states that the Travel and Vacation Industry is composed of all economic activity generated by the presence of tourists and vacationers in an area. The method of measurement is based upon data collected by means of a probability sample of business establishments, and involves the application of a "Difference Method."

Many groups and persons have studied the Travel Industry, but the measurement of the Industry has been secondary to other purposes. Two main criteria seem most important if such measurement is desired: an explicit definition of the Industry and a probability sample. Those studies that have possessed both properties have employed collection methods that were appropriate for certain regions, but not for others. The present study has attempted to devise a method that is adaptable to a variety of resort communities.

This study defines the Travel Industry as encompassing all expenditures by temporary residents plus any expenditures by permanent residents for the unique resort attractions of an area and any purchases that are necessitated by those attractions. This definition was developed by considering three characteristics of each expenditure: type of product or service, place of purchase, and person making the purchase. These characteristics were the bases upon which all expenditures were classified as either "travel and vacation" or "other." The decisions made were the ones that seemed most reasonable, but the classification system would be useful in developing alternative definitions.

The "PBD" Method was developed as appropriate for the collection of data for the above definition. It contains three fundamental elements: a probability sample that combines a List Sample and an Area Sample (P), data collected from business establishments rather than individual vacationers (B), and the application of a "Difference Method" (D). The List Sample is selected from a master list of lodging places, restaurants, service stations, public transportation companies, and places of entertainment. The Area Sample covers all other types of businesses plus any firms of the designated types that are not on the master list. Stratified non-proportional sampling is utilized in both samples. The selection of business firms as the sources of data was based upon cost consideration, accuracy of available data, and the ease of selecting a

probability sample. The actual collection process combines mail questionnaires and personal interviews. The receipts from some businesses are allocated according to a "Difference Method." This method is only an approximation, but the presuppositions involved possess merit in many resorts. The formula for the method is $TV = TR - k(LM)$; where k = number of months open during the year, LM = total receipts of the month in which volume was lowest, TR = total receipts for the year, and TV = receipts to be allocated to the Travel and Vacation Industry.

The complete "PBD" Method was tested in Atlantic County, New Jersey, for the calendar year of 1956. The total Travel Industry of the County was estimated as \$115 million with a coefficient of variation of 5.6%. Figures were also obtained for the distribution of the Industry among types of businesses, average volume per establishment by type of business, relative importance of the Travel Industry to different types of enterprises, and several other characteristics. There were no major procedural difficulties encountered, but the experiment indicated some details in the collection process could be improved in subsequent studies. These suggested revisions are noted in the dissertation.

Microfilm \$2.10; Xerox \$7.40. 160 pages.

AN EMPIRICAL COMPARISON OF THEORETICAL AND ACTUAL DECISION MAKING UNDER UNCERTAINTY

(L. C. Card No. Mic 59-2413)

John Louis Dillon, Ph.D.
Iowa State College, 1959

Supervisor: Earl O. Heady

The production decision problem facing an entrepreneur operating under free competition was examined. A game theory model of the situation proved unsatisfactory. However, by realizing the implications of a situation involving a large number of entrepreneurs whose decisions interact, and all of whom have only human capabilities, a more satisfactory normative model was derived. It met the exigencies of the real-world by assuming that the entrepreneur simplified the choice problem to a degree compatible with his mental capabilities; appraising some subset of his alternatives and considering but a few states of Nature specified as broad maneuvers possible by his opponents taken en masse. Nature's strategy selection being random, the decision problem devolves to a "game against Nature."

Using this constructed model, an empirical assessment was attempted of the normative and descriptive roles of the normative Laplace equiprobability, Wald maximin, Savage regret, Hurwicz pessimism-optimism index theories of choice and of the descriptive theories of Simon and Shackle. The empirical assessment was based on

1957 data relevant to a number of cattle feeding decision problems faced by a group of 77 Iowa cattle feeders.

Analysis indicated that, in its entirety, the postulated decision model has descriptive value for only a small proportion of the individuals studied. None the less, a majority of the farmers behaved in partial agreement with the model. All considered some simplified subset of their alternatives; 58 specified a primary choice influencing factor compatible with the model; 24 made allowances for two or more states of Nature.

The assessment of the theories of choice indicated that probably only the Simon, Laplace and Wald theories had any worthwhile descriptive value. Moreover, only a few of the respondents consistently used the same approach to each of the decision problems. The possible normative role of the Wald, Laplace and Savage theories was noteworthy. For the practical decision problems examined, the respondents would have been able to increase their expected profits by at least 21 per cent on the average if they had used these theoretical algorithms. While there were no salient differences between the Wald, Laplace and Savage procedures in the extent to which they reduced *ex ante* resource misallocation, the Wald and Savage procedures did tend to be more conservative than the Laplace criterion.

Microfilm \$3.15; Xerox \$10.80. 242 pages.

AN ECONOMIC ANALYSIS OF THE INTERRELATIONSHIP BETWEEN UNIONISM AND TECHNOLOGY: 1947-57

(L. C. Card No. Mic 59-2025)

John Davis Holmes, Ph.D.
University of Illinois, 1959

Since World War II, much attention has centered around the implications that automation has for various segments of the domestic economy. Because of automated changeovers, many unions have been forced to view the problems associated with automation and technological change in a new perspective. Similarly, management has been affected by the impact of automation, in part due to union demands arising from automation. This thesis attempts to explore the interrelationship between unionism and technology, and to examine the impact that automation had had on workers and the unions they represent in selected segments of the automobile, baking, and white collar occupations. Unions specifically examined in the study are the United Automobile, Aircraft and Agricultural Workers of America (UAW), the Bakery and Confectionery Workers' International Union of America (Bakery Workers Union), the Office Employees International Union (OEIU), and finally, the Brotherhood of Railway and Steamship Clerks (BRC).

The study is limited in time to the period since World War II, and in scope to an intensive study of the unions indicated above, first in terms of how these unions are affected by management's technological decisions and in turn how management is affected by the union's approach toward automation. Critical automation issues in union-management relations such as the impact of automation on the level of employment, wages, skills, displacement, productivity, and worker and management attitudes toward rapid technological change are examined. The method used

in the study in seeking to determine the extent to which automation has affected the factors listed above was that of a "before," "during," and "after" automation approach.

Based upon the findings of the study and an analysis of them, the following major conclusions were drawn. First, the technological policies proposed by the unions, and in several instances adopted by management, have had the effect of lessening the possible adverse effects of automation. Moreover, these policies reflect the institutional means of acceptance and adaptation to technological change. Second, based upon the case studied examined, management in general was found to have exhibited significant "social responsibility" toward workers adversely affected by automation. The above two factors, when taken together, undoubtedly have played a major role in promoting better union-management relations and adjustments to technological change. Third, in this study it was found that in general there was no substantial increase in the level of skills of workers in the plants studied. If this finding is true for the whole economy, the cost of training programs, especially where they are government financed, would have serious implications for public policy. Finally, there is ample evidence that automation's effects in some one industry are not necessarily the same as those in other industries. No two industries are alike, and even in the same industry there are substantial differences in the circumstances surrounding the development of automated equipment. These circumstances, at least in considerable measure, call for different union and management policies toward technological change.

In conclusion, this thesis accepts the implicit and fundamental assumption that automation's effects will be a benefit rather than a bane to the economy, provided that intelligent planning and adjustments are made by both the union and management. To the extent that this objective is realized, automation will accelerate the forces which have been largely responsible for technological growth in the American economy for nearly a half century.

Microfilm \$2.90; Xerox \$10.00. 223 pages.

GOVERNMENT ENTERPRISE: A STUDY OF THE INLAND WATERWAYS CORPORATION

(L. C. Card No. Mic 59-2365)

Kenneth Hall McCartney, Ph.D.
University of Minnesota, 1959

The government-owned corporation has become a familiar instrument for public administration of industrial and commercial programs. Basically, its growth has reflected a desire to achieve operational flexibility and efficiency in such activities. In addition, the device has been viewed as a means of implementing certain welfare objectives. Thus, a functioning "model corporation" has seemed an appropriate means for influencing private industry in the adoption of socially desirable standards in industrial relations, or for stimulating entry of private capital into a specific sector of the economy.

This study of the Inland Waterways Corporation, which conducted a common-carrier barge line on the Mississippi River System between 1924-1953, examines a particular government enterprise with respect to each of these points.

Chapter I presents an historical survey of the Corporation's development, operations, and financial result as background for an analysis of its functioning in three areas.

Chapter II is a study of the Corporation as a business enterprise. Although it was established to permit operation of the service in a manner comparable to private enterprise and to serve as a model for private capital interested in river transportation, it failed in both respects. The failure was caused partially by its original mandate to conduct simultaneously a commercial and a pioneering operation, which weakened its ability to function profitably. In addition, its governmental status led to serious deviations in internal organization and managerial policies from those of private enterprise, and subjected it to increasing limitations on its operational freedom.

Chapter III examines the Corporation as an employer. As before, it did not operate consistently either as a model or in a manner similar to a private firm. On the one hand, managerial inexperience and ineptness, legislative restraints, and a trend towards uniform conditions in the industry combined to preclude its functioning as a "leader." On the other hand, coverage of the Corporation under government personnel controls resulted in imposition of rigid policies inconsistent with private industry.

Chapter IV considers the Corporation as an instrument of public welfare. In this respect, it was intended both to rehabilitate inland water transportation -- particularly common-carrier operations -- and to extend the benefits of such transportation to the widest possible segment of the shipping public. Only a partial success was achieved. Its early work in development of floating equipment, terminals, and interchange facilities which land transport encouraged the growth of the industry and shipper utilization of the rivers. However, inability to solve some of the basic problems of a common-carrier operation, combined with the growth of bulk freight, prevented a sound development of that type of service.

The final chapter offers a general evaluation of the Corporation, and some concluding remarks on the government corporation as such. In assessing the Corporation, two sets of factors must be considered. One comprises essentially the nature of the political and legislative environment in which the Corporation was conceived and conducted. The other consists of elements characteristic of its internal operations, but not necessarily inherent in the government corporation. Of the two, the former category bears the major responsibility for the end result of creating an environment unfavorable to efficient conduct of the Corporation.

The analysis suggests that the corporate device is unlikely to be an effective organizational method for public enterprise unless certain minimal standards are met. These require an operative and unified public policy with respect to government corporations. Until this has been achieved, the corporation will not demonstrate its alleged values as a means of public administration.

Microfilm \$3.60; Xerox \$12.20. 279 pages.

GOVERNMENT CONTROLS OVER THE IRON AND STEEL INDUSTRY DURING WORLD WAR II: THEIR DEVELOPMENT, IMPLEMENTATION, AND ECONOMIC EFFECT

(L. C. Card No. Mic 59-854)

David Calvin Motter, Ph.D.
Vanderbilt University, 1958

Supervisor: Professor George W. Stocking

The purposes of this study were twofold: (1) to determine the economic effects within the steel industry of the World War II governmental programs for expanding steel facilities, controlling steel prices, and controlling steel production and distribution; (2) to determine the wartime effectiveness of these controls.

Several students of the steel industry held that its concentrated prewar structure made the beneficial results of effective competition unattainable. This study formulated the following criterion for measuring the degree to which wartime governmental steel policies conformed to the United States' traditional public policy goal of fostering competition; whenever a choice was available between policies which promised equal benefit to the war effort, those policies tending to decrease concentration should have been favored over those tending to maintain or increase it.

Facilities Policy. Since steelmaking facilities were being operated at near-capacity in 1940-1941, the additional steel required by the war effort could be secured only by capacity expansion. The government implemented the expansion by bearing half its cost and by granting rapid amortization certificates for privately-financed facilities. The major war-dictated criteria for project selection were the speed with which proposed facilities could begin production, the cost of construction per ton of capacity, and the estimated unit costs of production. Since existing firms had certain built-in advantages in meeting these criteria, it was inevitable that they would operate most of the government-financed facilities. Insofar as they were selected as operators on the basis of these criteria, the concentration criterion previously stated was not violated.

However, the Office of Production Management exhibited a greater predilection for scrambled facilities and for the selection of existing firms to operate new plants than was necessitated by wartime imperatives. The project proposals of potential entrants were largely ignored. The one new integrated producer that emerged from the war overcame great obstacles erected by the OPM. The inclusion of purchase options in operating contracts and the disposal agency's emphasis on speedy sales at the maximum immediate cash realization reinforced the structural effect of the neglect of potential entrants' proposals and the over-stress on scrambled facilities.

The wartime opportunity to effect a significant structural change was lost. Industry concentration as measured by ingot capacity remained approximately constant during the war. Two integrated producers acquired 61 per cent of all government-financed ingot capacity. The governmental facilities program failed to meet the concentration criterion.

Price and Production-Distribution Controls. The price control and production-distribution control program largely

determined the wartime operating and profit rates of steel companies. These programs affected concentration directly insofar as they aided or hindered the attempt of marginal producers to remain in business in the face of wartime difficulties, and indirectly through their influence over the financial position of producers at war's end.

On grounds both of equity and wartime product maximization, the OPA could not neglect the producers disadvantaged by the war. The agency granted individual price adjustments which increased the revenues of these producers while holding industry-wide ceilings constant. Without such adjustments, it is likely that a number of producers, especially in the semi-integrated and non-integrated categories, would have been forced to cease operations. Both the rationale and the implementation of the individual adjustment procedure were perfectly consistent with the concentration criterion.

Production-distribution controls provided a mechanism which, among other things, allowed non-integrated producers to secure semi-finished steel. In the division of the limited civilian-type steel products business, considerations of production maximization and equity called for a greater utilization of semi-integrated and non-integrated facilities, at the expense of certain integrated finishing operations, than was achieved by the War Production Board.

Wartime Effectiveness. While valid criticisms of wartime steel controls may be made, steel production in 1941-1944 did break all records. Approval of the facilities expansion program was delayed by the opposition of the steel industry and the military services. Once the program was inaugurated, it proceeded successfully, and new capacity was brought into production in 1943.

Steel price controls were ably and intelligently administered. The OPA attained stability in steel prices by mid-1941, and was able to avoid industry-wide price increases until early 1945. Controls over the production and distribution of steel were decidedly inadequate until late 1942. A comprehensive allocation system was delayed by steel industry opposition and by lack of requisite data and experience. The combination of production scheduling and the Controlled Materials Plan operated successfully from 1943 to the end of the war.

Microfilm \$5.95; Xerox \$20.80. 468 pages.

THE ECONOMICS OF THE PRODUCT-SATURATED ECONOMY

(L. C. Card No. Mic 59-2046)

Milton Linwood Myers, Ph.D.
University of Illinois, 1959

Modern economic analysis has not been properly concerned with problems stemming from the product-saturated economy. While the mainstream of economic thought continues to grapple with questions arising from the conditions of material scarcity, as it has been doing since political economy became a separate discipline, social conditions in the United States have evolved a long way from the widespread economic indigence which prevailed only half a century ago. Consumption now poses as much, if not more, problems than production.

Neo-classical economic thought relegated the study of consumption to a secondary position. Instead of considering the consumer as a total human being whose desires are subject to intangible and unpredictable forces, he was reduced to a cold calculator of pleasure and pain concerned only with his material existence.

In recent decades national income analysis has attained a position of deserved importance in economic theory. We still find, however, that the consumer is still unrecognized as a complete human being. While a step forward has been made in acknowledging his collective importance as an element in aggregate demand, he is still a faceless group subject essentially to the same economic forces as previously.

In short, that is where the main stream of economic thought stands today in respect to the consumer. Yet the problem of consumption has assumed a vastly new and important status due to the pervasive condition of economic abundance.

The businessman who has to face the enigmatic consumer day after day is very seriously concerned about him. Probably the best measure of this intense interest is what business is spending on product differentiation. This process, which varies the product either physically or promotionally for purposes of increasing its consumption, demands many billions of dollars yearly. At the present time over \$10 billion is being spent on advertising. Packaging commands about \$15 billion while research and development costs \$9 billion. Industrial design and public relations cause outlays of probably several hundred million dollars a year, although accurate statistics do not exist for either one. Finally, industry spends large sums in order to change its productive equipment so that the physically varied product can be manufactured. Alter the product, then machinery and tools must also be altered. This expenditure amounted to about \$1.5 billion for the automobile industry in 1958. Figures on these costs induced by annual model changeovers in other consumer durable industries do not seem to exist. They are probably considerable, however.

Such large-scale business activity as described above undoubtedly influences certain basic structures and procedures in the economy. One of these is product pricing. Varying the product tends to raise prices from two directions: (1) by increasing costs of production, (2) by increasing overall demand of the consumer. These upward pressures on prices are intensified by the fact that product differentiation reduces the price elasticities of goods. Advertising, packaging, and product redesign all create a diversion in the consumer mind and often effectively disguise price increases.

What are some of the welfare implications of product differentiation? If it can be assumed that consumer satisfaction rests on two foundations-- the functional and the aesthetic qualities in the product-- then it can be shown that a balance between these two objectives will maximize total satisfaction. Business spending for product variation should be adjusted so that the last dollars spent on improving the products' functional and aesthetic qualities create equal amounts of consumer satisfaction.

Microfilm \$2.00; Xerox \$5.60. 114 pages.

PROBLEMS CONCERNING THE SUPPLY AND DEMAND FOR DIRECT UNITED STATES PRIVATE INVESTMENT IN LATIN AMERICA FOR THE YEARS 1957-1965

(L. C. Card No. Mic 59-1407)

Rudolph August Postweiler, Ph.D.
The University of Wisconsin, 1959

Supervisor: Professor Theodore Morgan

Substantial quantities of capital will be necessary if per capita incomes in Latin America are to grow at a rate equal to the average postwar rate. In this study I have developed models which estimate capital requirements necessary to sustain per capita income growth rates of 2.25 and 3.25 percent per year. What are the prospects for achieving these capital requirements?

To a large extent these capital requirements will be fulfilled by domestic savings. However, to the extent that they are not, foreign capital sources must come into play. I have estimated both probable net domestic savings and net long term foreign capital inflows from postwar experience. For the most part these capital supplies (both domestic and foreign are inadequate to sustain the postulated economic growth. A substantial gap thus exists between projected capital requirements and supplies. If, as I have attempted to show, the rate of domestic capital formation cannot materially increase, the burden of the additional capital supplies must fall on foreign lending.

Since World War II, the greatest source of long term capital in Latin America has been United States direct private investment. From this observation it is an easy step to argue that any foreign lending gap can be resolved simply by inducing more of this capital to flow into Latin America. However, there are serious impediments to the international flow of this form of capital. In this study several proposals are made which I believe will eliminate or minimize these impediments.

In general these proposals are:

A. The United States should furnish, on a grant basis, Latin American countries with substantial supplies of social-economic overhead capital, thus increasing Latin America's ability to absorb general market capital through the creation of technological and pecuniary external economies.

B. As regards United States direct private investments I propose:

(1) The elimination of the United States corporate profits tax on direct investment income. (2) The establishment of a United States government investment guarantee program which should be made available to all United States direct investors. Furthermore, the guarantee program would be integrated with the grant program in such a manner that failure to remit earnings, amortization proceeds, etc. on the part of a foreign country party to a guarantee agreement will result in a reduced grant program. (3) The United States Congress should formulate a workable anti-trust policy as regards United States direct investments in Latin America.

C. The United States should extend the guarantee program to include the convertible securities of the International Finance Corporation, thus extending the United States capital market for these securities to American investment funds.

I argue that if my proposals are adopted, a reasonably good chance exists that the required capital inflows given by my models will materialize. On the other hand, if my proposals are not adopted, I do not believe that sufficient capital supplies, domestic and foreign, will become available to sustain the postwar growth, 2.25 percent per year, or the more desirable growth rate of 3.25 percent per year. Microfilm \$3.80; Xerox \$12.80. 293 pages.

THE LAND TENURE STRUCTURE OF MALABAR AND ITS INFLUENCE UPON CAPITAL FORMATION IN AGRICULTURE

(L. C. Card No. Mic 59-2273)

Thomas William Shea, Jr., Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Irving B. Kravis

This thesis is intended to enhance our understanding of the role played by land tenure in the agricultural economy of emergent countries. The term "land tenure" is applied to economic institutions and legal forms relating to rights to occupancy of and/or income from land. It includes size of holdings, the contractual relation between landlords and tenants, and the distribution of the proceeds from agricultural operations among the various claimants. Land tenure patterns help to determine the volume and character of capital investment through their incentive and distributive effects.

Although there are several theoretical barriers to a rigorous separation of the determinants of economic development into those which are attributable to one or more components of the land tenure structure and those which are traceable to causes other than land tenure, the greatest difficulties are practical. These include the prevalence, in many densely populated areas, of subinfeudation and fragmentation of holdings, the presence among most agricultural families of multiple income sources, grave defects in the state of public and private land records, and the absence of reliable information on yields and costs of cultivation. The generally defective nature of information on agricultural costs and yields in most underdeveloped countries inhibits effective evaluation of the economic role played by the land tenure structure.

Chapter I is devoted to the construction of a theoretical model showing the relationship between land tenure and its determinants on the one hand, and land tenure and its role in determining input patterns in agriculture on the other. Chapter II presents suggested solutions to certain practical problems of land tenure research. The remainder of the thesis is an attempt to apply the theoretical framework and analytical techniques outlined in the first two chapters to a study of land tenures in an area characterized by dense population and a highly complex tenancy structure. The area chosen is Malabar District of Kerala State in India.

The land tenure structure in Malabar appears to act as a serious deterrent to economic development. Its major defects are found to be: (1) insecurity of tenure; (2) the exactions of high rents by passive rent receivers; (3) the uneconomic size of cultivators' holdings; (4) excessive concentration of income in the hands of non-investing classes; (5) widespread subinfeudation. The existence of

these defects may be traced partly to erroneous court interpretations concerning the nature of customary land rights in the district, which undermined the economic position of cultivators and investors, partly to the structure of incentive patterns in Malabar society, which assigned a low prestige value to agricultural operations, but a high value to the holding of agricultural land, and partly to a complex set of inheritance laws which brought about the existence of large, poorly-administered estates owned by non-cultivating joint families, and of cultivated family holdings of uneconomic size. Recent land tenure legislation has reduced rents and granted security of tenure to most cultivators, but has done nothing to remedy the remaining defects. Although it is too early to determine whether or not the effect of tenancy legislation on cultivation will ultimately be favorable, it is unlikely that any change will take place so long as nothing is done to improve the organization of agriculture. Future reforms, if they are to raise productivity, will necessarily involve displacing a large proportion of the population currently dependent upon agriculture, and must therefore be part of a comprehensive development program for the economy as a whole.

Microfilm \$4.60; Xerox \$15.40. 357 pages.

THE ADVERTISING APPROPRIATION IN THE RUBBER TIRE INDUSTRY: A STUDY IN DECISION-MAKING

(L. C. Card No. Mic 58-7109)

Fremont A. Shull, Jr., Ph.D.
Michigan State University, 1958

This study examines decision-making concerning advertising appropriations in the rubber tire industry. The empirical evidence, collected through interviews and a questionnaire, permits the description of several aspects of the decision for a typical firm. Advertising, for example, is viewed as a significant sales technique, but it is believed that increases in expenditures call forth less than proportionate increases in sales. As a retaliatory device, advertising is ranked second to quasi-price adjustments, e.g., offering a free tube with each tire. This does not imply that pricing and product development are unimportant. The theoretical proposition seems to hold that when all but one of the sales techniques are adjusted optimally, adjustments in the one remaining have more effect than modest changes in the others.

The broad objectives of advertising are to stimulate consumer purchases and dealer support. Some attention is given to the effect of advertising in the securities market but little in the labor market. Specific objectives in terms of protecting prices versus maintaining volume are not clear. Industry executives believe that advertising cannot completely offset the price consciousness of consumers but that advertising is somewhat substitutable for price reductions.

Advertising is viewed as a highly discretionary expense item. The allocation is mechanistically related to short-run sales forecasts. The typical approach is to apply a percentage-of-sales figure to the sales forecast in order

to establish a maximum limit. If the total request exceeds the acceptable limit, it is decreased by progressively reducing the more discretionary items.

The questionnaire showed three primary determinants of the appropriation: financial condition, the need to satisfy dealers, and inventory position. The interviewees suggested that in the final committee decision a per cent of profit rule was used.

The monthly allocation varies directly with seasonality of demand. The proportion of the immediate-sales type of advertising in the total effort determines the extent of the relationship. The small firms appear to have a higher proportion of this type of advertising, so the relationship between monthly allocations and seasonality of demand is greater for the small firm than for the large.

One group of firms places little confidence in the ability of advertising to sell growing inventories without an off-setting price reduction while the other group shows high confidence. Those with the least confidence in the use of advertising in this way believe, however, that advertising is essential to sell to dealers and their appropriations are less mechanistically related to short-run sales forecasts than those of the high confidence group. Other answering patterns were disclosed.

In total, such answering patterns were consistent and explainable in terms of institutional goals. Although an attempt was made to discover respondents serving their own personal ends at the expense of the objectives of the firm, little evidence of this nature was found. In only one instance, for example, did the findings indicate that they were more concerned with departmental needs than with the requirements of the overall organization.

Microfilm \$4.50; Xerox \$15.00. 349 pages.

THE PRACTICE AND OPERATION OF INDUSTRIAL PENSIONS

(L. C. Card No. Mic 59-2321)

Clarence Alfred Slocum, Ph.D.
The Ohio State University, 1953

The study includes the reported practical experience of 614 large and small corporations, many nationally known, which have pension plans for the retirement of their employees. The study was designed:

1. To investigate the extent of pension coverage by major occupational groups of employees
2. To investigate retirement practices as contrasted with retirement objectives and ideals
3. To investigate the extent of monetary benefits provided for retirees and nonmonetary benefits received by corporations as a result of pension programs provided
4. To investigate plans for providing funds for pension programs, and for their administration.
5. To indicate similarities and differences in practices between industries and between companies of differing sizes within an industry

Planning for pensions is a comparatively new and

important function. To establish, liberalize, curtail or abandon a pension plan is a management decision which can seriously affect the entire future of the enterprise. Historical data on practices and operation of pension plans are meager. The experience of pension administrators tabulated in the study may be helpful to other executives charged with this responsibility, whether it is for the purpose of establishing a new plan or for the purpose of revision of old plans.

Agents of insurance companies furnished the names of approximately 800 corporations without the knowledge of the parent insurance company. One insurance company home office supplied approximately 800 more names of corporations for which it had written annuities, many of which were written for the purpose of establishing funds for pension plans. Labor unions cooperated by furnishing names of 50 corporations with whom they had negotiated pension plans through collective bargaining. The recently negotiated pension contracts with automobile, rubber, and big steel corporations are not included in the study.

The Bureau of Labor Statistics opened certain files from which names of approximately 60 concerns with uninsured pension plans were secured, and the Department of Federal Security did the same, supplying names of approximately 200 additional uninsured plans. The files of the Bureau of Business Research at the Ohio State University yielded approximately 70 more corporation names with retirement pension plans.

A total of 1997 questionnaires was mailed during the last week of July, 1950. Questionnaires completed and returned during the month of August, 1950, totaled 614 and were coded for study.

Since no census of the pension universe exists, it would be difficult to indicate the extent of coverage represented by the sample. It is reasonable to assume, however, that only a relatively small part of the universe was covered by the study. However, on the assumption of a relatively high degree of homogeneity in the classifications used (such as industrial classifications, classifications of industry by size, and the relative magnitude of labor cost classification), some generalization for these various groups might be made even with this limited sample of 614 firms.

In one respect the sample may be considered to be distributed similarly to an important segment of the pension universe. Pension plans are very often classified according to their method of raising funds, or according to their method and plan of administration. Insured, trustee, or pay-as-you-go are the broadest and most frequently used terms of description. Data supplied by The Tally of Life Insurance Statistics for 1950 shows that 69 per cent of the plans (9,600 of a total 13,899 plans) approved by the Bureau of Internal Revenue for tax exemption were insured plans. One indication of the similarity in the distribution of the types of plans included in the sample with that of the pension plans approved by the Bureau of Internal Revenue is that insurance companies administer or help to administer a total of 66 per cent of the plans included in the sample. If it can be assumed that insurance companies would not administer any plans other than insured plans, then certainly the two distributions, on the basis of method of raising funds or of administration, are very similar.

Evidence of management interest in the subject of retirement pensions is indicated by the prompt return of such a high per cent of a detailed seven page questionnaire and by the answering of a very high percentage of all questions

asked. Voluntary signatures and comments were furnished by more than half the respondents.

The higher a pension is in the corporation hierarchy, the higher the percentage of pension coverage. In 70 per cent of the firms studied, 100 per cent of top management executives were included in pension plans. In an additional 14 per cent of firms, 30 per cent or over of top management executives were included. Operative executives were next highest, with 100 per cent of that group included in the pension plans of 69 per cent of the firms. Only 44 per cent of the firms in the study included 100 per cent of their white collar workers in pension retirement provisions and as few as 36 per cent of the firms studied included 100 per cent of their laborers in their retirement plans.

A higher percentage of companies in the manufacture of durable goods employing 500 persons or less pay the entire costs of pensions for all major occupational groups than of such firms employing over 500 persons. Replies indicate that in firms manufacturing nondurable goods approximately 60 per cent of small firms paid all pension costs for employees.

As the number of employees increases in firms, the percentage of firms having optional contributions to the pension plan increases. More firms provide for optional contributions to pension funds for executives than provide for contributions by white collar workers and laborers.

Approximately 35 per cent of all firms require less than 2 years of employment by all major occupational groups to become eligible to participate in the benefits of a pension plan. About 32 per cent of all firms allow employees to participate in pension plan benefits after from 2 to 4 years of employment, and another approximately 30 per cent of the firms cover all occupational groups after from 5 to 6 years of employment. Approximately 23 per cent of the firms answered that 25 years of employment are necessary to become eligible to full retirement benefits.

This indicates a trend towards reducing the number of years of employment necessary to qualify for full participation rights in a pension plan.

A specified age for retirement is mentioned in most pension agreements. Sixty-five is the age most mentioned, with approximately 93 per cent of all companies indicating that age for all groups of male employees. No age limit for retirement was indicated by approximately 3 per cent of the firms included in this study.

Although there is a specified age for retirement in pension agreements, three times as many as follow the contract report that they violate that provision in the pension agreements. Financial institutions were highest in adherence to the rule, with 47 per cent reporting that they retired employees at specified retirement age. Construction was lowest, with only 13 per cent answering affirmatively.

Most firms included in this survey provide other employee benefits in addition to pensions. Three or more additional benefits were reported by 546 firms. Four or more additional benefits were indicated by 460 of the 594 firms replying, and 376 firms said that they provided five or more benefits for employees in addition to pensions.

Investigation was made to see if the company providing benefits to employees received any benefits from the employees in return. Ninety-seven per cent of the 572 companies indicated that the corporation received one or more benefits in return for pensions. Reported benefits to the firm included increased production, reduced waste, better

morale, better quality, better public relations, greater loyalty, and lower labor turnover.

The extent of monetary benefits provided for retirees was found impossible to tabulate from the replies received.

More firms established pension plans voluntarily for executives and white collar workers than for laborers. There were only eight firms with other than voluntary plans for executives.

More pension plans were established as "fringe benefits" for laborers than for any other of the four major occupational groups. A fringe benefit is any compensation extended instead of a salary increase, paid vacation, or other financial gain. Pensions as fringe benefits were established for general administrative executives and operative executives in all industry classifications except in mining and in transportation, while white collar workers and laborers received them in all classifications except transportation.

Collective bargaining was used in the establishment of six times as many pension plans for white collar workers as those for laborers. Only three large manufacturing firms and one small corporation report the use of collective bargaining procedures in establishing pension plans. Twenty-one large manufacturing firms and 4 small companies, one large construction firm, and one large mining company employed collective bargaining as a means of establishing pension plans for white collar workers. Twenty-seven of the 434 white collar worker plans used collective bargaining, but only 4 of the 587 labor plans reported indicated the same procedure.

The smaller a firm was, the more it used the services of insurance companies to design its pension plan; the larger a firm, the more it used the services of independent pension consultants, trust companies, and its own firm officers to design its pension plans.

Higher percentages of financial institutions and public utilities used the services of insurance companies as designers of pension plans than did any other type of industry. Manufacturing was strongest in using combination of two or more designing agencies.

The larger a company becomes, the more it is inclined to administer its own pension program. All companies with over 50,000 employees administered their own pension programs. Joint administration with the union was reported in only two companies of the 605 reporting on this phase of administration. Of the 88 firms reporting trust company administration, 55 were in the manufacturing industry.

Pension plans are revised to meet changing conditions as the need arises. Of the 614 companies included in this study, 279 of them had at one time or another revised their pension plans. More revisions were made after 1946 than during any other period specified. Many firms reported that their pension programs were too recently inaugurated to warrant any revision yet.

A minority of the plans used Social Security to supplement pension payments. Twenty-three per cent of the firms with plans for executives and white collar workers reported plans with complementary amounts to Social Security, and 26 per cent reported the same for laborers. Construction, mining, and transportation had no such provisions for general administrative executives, nor did construction have such provisions for white collar workers, but all other industries and occupational groups came within such plans for complementing Social Security payments. Retail trade made use of more plans with Social Security provisions for all employee groups than did any other

industry. Large manufacturing companies made more use of Social Security benefits than did smaller manufacturing firms.

Two financial institutions with less than 500 employees indicated that the cost of pensions was paid for at the expense of quality. No other firms indicated such an incidence of costs. Forty-two firms, including some from every industry except wholesale distribution, indicated that extra efficiency on the part of employees, because of a pension plan, provided funds to pay pension costs.

Ninety companies said that the cost of pensions was passed on to the consumer. More firms indicated that funds for pensions came out of profits than from any other source, with 277 indicating this source of funds.

Pension plans are now being operated by companies with a comparatively small personnel force rather than being confined to just the larger firms. Only one in four of all plans examined have provision for optional contribution by the employees. Pension plans were more commonly in operation in manufacturing corporations than in any other type of corporation.

Pension plans have been in operation for too short a time for many companies to estimate the possible need for revision. Few firms keep close accounts of the costs of pensions for the various occupational groups, it seems, since they are unable to allocate pension costs. However, it was generally agreed that beneficial returns from employees accrued when pension plans were installed. Most companies answered this question in the affirmative, but none of them could compute these returns in terms of dollar value. It was also found that many firms were liberalizing their pension benefits in order to help retired employees live better during an inflationary period.

On the whole, the majority of the companies reported satisfaction with their pension plans, most of the plans studied being installed voluntarily by the firm because the chief officers and stockholders thought it good business to have pensions for all employees.

Despite the fact that legislation has made pensions a legal instrument for collective bargaining, only four pensions for laborers have been established as a result of collective bargaining.

It is recommended that age limit clauses for retiring employees be adhered to or rewritten, since the present practice causes many conflicts.

The publicity, advertising, and labor relations departments should more actively publicize the company's plan. It is not enough that the plan be explained to employees at its inception; it must be sold and resold to obtain maximum returns. Many comments were received in the course of the survey that employees did not appreciate what was being done for them by the company. Inadequate publicity could account for this negative reaction.

The requirement of 25 years continuous service with one company in order to qualify for pension benefits is incorporated in many of the plans. In the case of a non-vested plan, this means that no benefits accrue to the employee who terminates his employment before the expiration of this time unless the plan is a contributory one. It has been authoritatively stated that pensions are an integral part of wages; it is therefore recommended that all plans be vested, and that separation from the payroll for any causes, except perhaps dishonesty, should not preclude an employee's right to the accumulated contributions made to his credit.

It is further recommended that an escalator clause be inserted which would be tied to the cost of living index determined by the revised Bureau of Labor Statistics.

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THE ECONOMIC CONSEQUENCES OF REGULATED MONOPOLY TAXATION

(L. C. Card No. Mic 59-2329)

Ivon William Ulrey, Ph.D.
The Ohio State University, 1953

Taxation of privately owned transportation, communication, electric power, gas, and other public service companies directly affects virtually every member of society. If taxes rise, the consumer very likely will pay higher charges for his utility services. At least, higher taxes will keep the costs of those services higher than they would be otherwise. This is not a value judgment but rather the restatement of a generally recognized effect of taxation. The point being emphasized is that the taxation of the "natural monopoly" segment of the business economy is very likely to be felt by a larger portion of the nation's population than for most other taxes. Despite this, relatively little effort has been made to trace the economic effects of taxes and tax changes on the consumer, the producing firm itself, and the public generally.

The work done on the subject has been directed either toward measuring the relative burden of taxes on the various classes of utility service producers or toward the establishment of model tax systems. Something more is needed - an analytical system making it possible to predict the probable immediate and ultimate economic consequences of regulated monopoly taxation. The purpose of the dissertation is to build such a system of analysis.

It is not hard to find the reason why more theoretical work has not been done in the field. The economic environment in which such industries have developed has appeared to make tax problems relatively unimportant. Early in the historical life of each of these industries, the public wanted and needed the services of all available producers, and their growth was encouraged even to the extent of granting them large subsidies and tax concessions. Later, after these firms had grown to business maturity and become, in many cases at least, quasi-monopolistic, the attitude of the public changed and the emphasis shifted from subsidy or aid to rather heavy taxation and regulation. Tax problems, however, were given relatively little attention because it was generally expected that firms burdened by taxes would be granted appropriate service rate adjustments by the public commissions.

Peculiarities of Regulated Monopoly

Conventional monopoly taxation theory does not fit regulated firms. One reason for this is that in unregulated monopoly theory the firm is assumed to be perfectly free to adjust output and price in order to maximize its profits. The regulated firm does not have this opportunity because its prices are generally controlled by the regulatory commission.

Stated in another way, monopoly theory assumes that the firm can and will adjust output and price to maximize profit. The regulated firm is not free to make such adjustments. The only adjustment it can make is to alter its capacity to match the quantity of service demanded at the price set by the regulatory body. Therefore, the regulated monopoly strives always to have its plant operating at its low cost rate when producing the quantity its consumers are demanding of it at the authorized rate. The adjustment for the regulated firm becomes a capacity adjustment and not a simple adjustment of output within a plant as it is described in monopoly theory. The resulting equilibrium point for the regulated firm will be where the quantity demanded is just equal to the rate at which the firm can produce when operating at its low cost rate of production. This is an entirely different concept of equilibrium and is fundamental to the whole regulated monopoly analysis.

Regulated monopoly firms are unique in another respect. Whereas conventional monopoly theory assumes all monopolies to be monopoly-profit-making monopolies, regulated monopolies may earn only a "normal" profit or even less than that amount. In the unregulated segment of industry, the level of earnings is a test commonly used to identify monopolies which are, by definition, firms that enjoy "monopoly profits," but in the dissertation the firm referred to as a regulated monopoly may or may not pass this profit test. In fact, the usually accepted concept of a regulated monopoly envisions a firm that always enjoys a "normal" or "minimum" profit and no more. In practice, some regulated firms earn more than enough to prosper financially while others earn the "normal" amount and still others less than that. Regulated monopoly analysis, then, requires a new set of assumptions and a new concept of equilibrium.

With a new definition of monopoly, a new set of assumptions, and a new concept of equilibrium, new and perhaps different insights into the consequences of tax changes become possible. Instead of concluding that the effects of the tax change will depend on the size of the tax, the kind of tax levied, whether the tax is universal or special, and the other factors usually considered, the researcher must, in this case, take into account additional variables. The dominant one, of course, is the policy of the regulatory body. If a tax is imposed for the first time, increased, decreased, or abolished, the effects depend, first, on what the regulatory body does, and, second, on the factors usually considered. This dominant position of the regulatory commission often leads to the statement that the economic consequences of taxes themselves are regulated. This is indeed true, but such a statement overlooks the regulatory problems that arise when the taxes are changed. Action (or inaction) by the regulatory agency or agencies has different effects under each set of circumstances, and each possible situation requires careful analysis.

Study of the many factors involved leads to the conclusion that any particular tax change may or may not create conditions dictating a change in authorized service rates. A change in a service rate that is calculated to cover the change in the tax rate may set off a chain reaction which involves many factors and only works itself out over a considerable period of time.

Short-run Analysis

Despite the long list of variable factors that influence the economic outcome of a tax change, certain new and

important effects may be traced by means of the analysis provided by the dissertation. For example, in the short run, any additional tax imposed on a regulated monopoly will reduce the firm's profits by the exact amount of the tax unless the regulatory body authorizes an increase in service rate. In fact, even if the regulatory commission authorizes a rate increase, the firm will have its profits reduced if the new higher rate destroys business or diverts sales to other producers or to substitutes to such an extent that the effect on profits of the increased service rate is more than offset by reduced sales. These statements assume, of course, that the demand is not perfectly inelastic and that the demand and cost functions do not change.

It may also be stated by means of the new analysis that if the regulatory body authorizes an increase that raises the service rate to a level equal to the pretax service rate, the effect of that increase may be to increase, to leave unchanged, or to decrease the profits of the firm upon which the tax was imposed. Furthermore, inasmuch as this study takes into account firms that are not enjoying "above normal" profits, the tax described, if followed by the rate adjustment assumed above, may cause firms earning "normal" or "less than normal" profits either to suffer or to benefit financially.

The important statement contained in the analysis is that the tax may have any of the effects described. Therefore, the economic consequences of a tax change cannot be foretold unless the variables are known. This is a very different conclusion from that reached by established monopoly theory, which implies that the tax change described would necessarily cause lower profits. Conventional analysis does not lead to the conclusion that the firm might actually earn higher profits after the tax and rate adjustment than before. Neither does it make possible additional insights into the economic repercussions on the firm.

Conventional analysis cannot recognize the possibility that the profits might be increased or remain unchanged because it assumes that the firm always operates at such a low rate of production that it cannot minimize its unit costs of production. This is the rate where marginal revenue equals marginal cost and where profits are maximized. Under these circumstances, any further reduction in output would inevitably reduce profits. On the other hand, regulated monopoly equilibrium analysis, developed in the dissertation, emphasizes that if the firm were in equilibrium — operating at its minimum cost rate of production — before the imposition of the tax, the tax increase would indeed place the firm in a less profitable or more unprofitable position. But it shows also that, under these circumstances, a moderate reduction in output from its low cost rate to a slightly lower rate is likely to raise unit costs of production less than a comparable reduction which takes place from a rate that is already less than the firm's low cost rate to an even lower one. This is important, but even more important is the possibility that the regulated monopoly may operate at a rate in excess of the low cost rate. When this occurs, the firm will actually benefit financially if the imposition of a tax causes the regulatory body to authorize a rate increase and reduces its output because its unit costs will be lower at the lower rate of production. Such a situation may arise because of "lumpiness" or "indivisibility" of factors.

Long-run Analysis

It will be noted that the situations described do not take into account what might happen over a period of time

when price, demand, costs, and the relations among them may change. As an example, suppose that demand does not change and that the service rate is increased only enough to cover the tax, assuming constant output. Under these circumstances, the service rate increase will reduce the quantity demanded, and in turn reduce output. When this happens, the firm will promptly alter capacity to make the low cost point on the unit cost curve coincide in quantity with the smaller quantity demanded. The result of this capacity change will be to minimize the reduction in profits or the increase in losses. This conclusion is based, of course, on another assumption, that of constant costs. This is likely to be applicable to some but not all segments of the regulated monopoly sector of the economy, depending on the extent to which the scale of operations affects unit costs of production, the degree to which capacity can be adjusted to match the new lower quantity of service demanded, and the rate and significance of technological changes in the industry.

If the production characteristics of the industry permit capacity to be adjusted rather precisely to equal the quantity demanded, and if technological improvements are regularly being made, it may be that the unit costs of production will not be any higher, may possibly be lower, for the smaller volume of production than for the larger quantity. Under these circumstances, consumers will be paying more for less service but the regulated firm will be in almost the same position with regard to profits that it was before the imposition of the tax. If, however, the industry is characterized by economies of scale, by lumpiness of factors, and by the absence of technological improvement, the unit costs of production in the larger plant may be little or no higher than they would be in any other plant even though the larger plant is no longer operating at or near its low cost rate. In this event, the firm may be unable to improve its position by making a capacity adjustment.

These hypothetical examples illustrate how the dissertation contributes to an understanding of the economic repercussions of taxes. Perhaps its chief contribution is to demonstrate three things. (1) The assumptions applicable to unregulated monopoly are not satisfactory for regulated monopoly analysis. (2) The equilibrium theory used for conventional monopoly analysis does not fit the regulated monopoly case. To overcome these obstacles, a new set of assumptions and a new equilibrium theory have been worked out. Together, they provide a sound basis for the discussion of the economic repercussions of taxation on this segment of industry. (3) While these new assumptions and the new frame of reference produce a more realistic basis for analyzing the repercussions of taxation of regulated firms, the economic repercussions of taxes are much less predictable than conventional analysis would suggest. In fact, the dissertation bears witness to the statement that empirical data are urgently needed to make it possible to identify clearly the characteristics of the variable factors involved in each particular branch of regulated industry.

Hypothetical Models

The method of analysis used is abstract and deductive. Hypothetical models are constructed to show the probable economic consequences of the imposition of a lump sum tax, a tax on gross revenues, a tax on each unit of service sold, and, finally, a tax on net income. The effects of these taxes are examined under circumstances in which the firm is operating at its low cost rate of production, at a rate in

excess of its low cost rate, and at a rate below its low cost operating rate. The repercussions are also examined for model firms that are assumed to be making more than normal profits, normal profits, and less than normal profits.

Taken together, these working models probably are representative of a substantial portion of the practical everyday situations and demonstrate the outcome of the imposition of each of the four kinds of taxes on privately owned and publicly regulated businesses.

A Sample Case

Suppose the legislature of a state is considering the imposition of a new ton-mile tax on all motor freight carriers operating within the state and that the revenue collected from the tax will be used exclusively for road construction and maintenance. Can the theoretical tools provided by the dissertation help authorities determine what will be the effects of this tax?

The answer is that these tools form a basis for indicating both the immediate and the ultimate effect of the tax. The immediate effect will be to reduce profits or to increase losses by the amount of the tax, unless, of course, the regulatory commission authorizes the firm to increase its service rate. The ultimate effect will depend on several factors, one of which will be the action or inaction of the regulatory commission.

Suppose now that the commission authorizes the carrier to increase its service rate by an amount just equal to the tax adjusted to a unit cost basis, the adjustment being calculated on the assumption that the traffic would neither increase nor decrease by reason of the service rate increase. Actually, if the tax is imposed and the service rate is increased, the quantity of service demanded will decline and the volume of business done by the carrier will be reduced. If the volume of business is reduced, the unit costs of providing the service will change. They will not increase necessarily. The firm may be able to adjust its capacity promptly and thereby avoid wholly or in part the increased unit costs that usually accompany a reduction in the output in a given plant from its low cost rate to a lower rate. If, by means of a capacity adjustment, increased unit cost can be avoided, the adverse effect on profits will be limited to the reduction in sales volume.

If, on the other hand, the firm happens to be operating at a rate in excess of its low cost rate and at rather high unit costs at the time the tax is imposed, the reduction in sales following the service rate increase may actually reduce unit costs. Under these circumstances, the ultimate effect of the tax may be to increase the profits of the firm rather than to reduce them. The consumer, however, under the circumstances described, will still pay more total dollars for less total service than before the service rate increase. The ultimate repercussions on the consumers and the firm will depend, in large part, on the action of the regulatory commission, but demand, cost, and capacity adjustment factors also influence final results.

The reason for describing this illustration is that a tax increase followed by a service rate increase and reduction of sales does not necessarily cause unit costs of production to rise. When they decline, the service rate increase need not be by an amount equal to or greater than the full amount of the tax. A smaller increase may be sufficient. Established monopoly theory, it will be recalled, would indicate that the service rate would need to rise by an amount greater than the amount of the tax. The dissertation proves logically that this is not necessarily true.

Conclusion

It is possible, on the basis of the techniques worked out in the dissertation, to indicate to the policy makers what will be the probable economic consequences of the imposition of taxes on regulated monopoly firms. Not only does it show the inapplicability of conventional monopoly assumptions and analysis to regulated monopolies; it provides a new set of assumptions and a new frame of reference in the form of a regulated monopoly equilibrium concept. It also demonstrates the usefulness of its new analytical system on the basis of hypothetical models and cases. Finally, it provides useful analytical tools for doing empirical research on concrete problems.

Microfilm \$2.85; Xerox \$9.80. 217 pages.

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FACTORS ASSOCIATED WITH THE INCIDENCE OF LOW INCOME FARMS IN ILLINOIS AREAS

(L. C. Card No. Mic 59-2066)

Walter Lavon Wilson, Ph.D.
University of Illinois, 1959

The purpose of this study was to determine causes of persistence of differences in the incidence of low income farms among Illinois areas. The percent of farms in low income groups was expressed as a function of 7 independent variables as indicated below. Standard errors are given in parentheses below the regression coefficients.

$$Y = .644 - .168X_1 + 2.940X_2 - 2.210X_3 + .960X_4 + .076X_5 \\ + .696X_6 + .089X_7 \\ (.039) \quad (.674) \quad (.433) \quad (.148) \quad (.073) \\ (.213) \quad (.109)$$

The coefficient of multiple determination equals .910.

Y = The total number of commercial class V and VI farms, plus parttime and residential farms in the county, as a percent of all farms in the county.

X₁ = The total acres of land in farms in the county, divided by the total number of farms in the county.

X₂ = A soil productivity rating, derived from the percent of total land in the county in each productivity class (classes from 1 to 10, with 1 being the most productive soil).

X₃ = The total number of tractors in the county per 1,000 acres of cropland in the county.

X₄ = The total number of farm operators in the county working 100 days or more off farms, as a percent of all farm operators in the county.

X₅ = The total number of persons 14 years of age and over in the county engaged in agriculture, as a percent of total employed persons 14 years of age and over in the county.

X₆ = The total number of rural farm persons in the age groups of under 15 and over 65 years in the county per 100 rural farm persons in the age group of 15 to 65 years in the county.

X₇ = The total number of rural farm persons 25 years of age and over in the county with elementary schooling only, as a percent of all rural farm persons 25 years of age and over in the county.

X_1 , X_2 , X_3 , X_4 , and X_5 were significant at the probability level of 5 percent. X_6 and X_7 were not significant.

The persistence of differences between areas in the incidence of low income farms represents a departure from an optimum as defined by economic principles. Expressions of agricultural economists, characteristics found to be associated with the incidence of low farm income in specified low and non-low income areas in the United States and Illinois, and resource allocation theory, suggested hypotheses regarding the persistence of differentials in the area incidence of low income farms in Illinois. Variables, based on data from all Illinois counties, were associated by the above multiple linear regression.

The inverse relationship found to exist between the area incidence of low income farms and the factors, acre size of farm, soil productivity, and nonland capital inputs, indicated that physical land and capital resources per farm were lower in areas with a high incidence of low income farms, than in areas not so classified. The direct relationship found to exist between the area incidence of low income farms and the proportion of unproductive persons in the rural farm population suggest the existence of a greater number of persons per value unit of physical resource in areas with a high incidence of low income farms than in areas with a low incidence of such farms.

These relationships indicate that a lower value of physical agricultural resource per capita farm population is combined with labor in producing an aggregate product which must be shared by more persons in areas with a high incidence of low income farms than in those with a low incidence.

The analysis suggests that the primary causal factor in the persistent differences in the incidence of low income farms in Illinois areas is low quantity of physical agricultural inputs relative to the number of persons on farms. When viewed in terms of efficiency in resource allocation, this implies relative immobility of human and physical resources.

Microfilm \$2.00; Xerox \$5.40. 108 pages.

ECONOMICS, AGRICULTURAL

RELATION OF FERTILIZATION RATES TO PASTURE YIELD AND UTILIZATION

(L. C. Card No. Mic 59-2419)

William Owen McCarthy, Ph.D.
Iowa State College, 1959

Supervisors: Earl O. Heady and Karl A. Fox

Any farmer decision maker who uses fertilizer on a crop is concerned with at least two problems relating to the amount of fertilizer which maximizes profits. First, crop yield is uncertain. Thus the quantity of fertilizer applied may not be optimum for the yield actually obtained. Second, at the time of planting, future crop use may also be indefinite. The value of the alfalfa may differ according to the method of utilization. Hence a particular amount of fertilizer applied in the spring may not maximize potential value product.

This study is concerned with these problems as they relate to the P_2O_5 and K_2O fertilization of an alfalfa crop, from which three cuttings were obtained throughout the growing season.

For yield estimation and derivation of economic optima, a quadratic type of function was considered to fit the data best. The function included linear, squared and interaction terms.

Initially, the analysis estimated optimum quantities of fertilizer to use under different capital and resource use situations. The number of cuttings expected per year was assumed known with certainty.

Subsequently the analysis moved closer to reality by no longer assuming a priori knowledge of the number of cuttings harvested each year.

The most complex situation analyzed was that in which both the number of cuttings and utilization were considered uncertain, at the time of application of the fertilizer. This problem was treated as one of decision making under absolute uncertainty (a game against nature). Three decision making criteria (Wald, Hurwitz, Laplace) were then applied in order to determine what course the farmer should follow. Each criterion pointed to the same act as being optimal. Use of game theory did not guarantee that the act chosen was true ex post. In addition, price expectations were still uncertain for the act chosen. However it was shown for this particular set of data that if decisions were based on the criteria, variations in net returns were small even if price expectations proved incorrect.

There are some dangers in using production function data for predictive purposes. Recommendations may be made on the basis of one experiment carried out under particular environmental conditions over a single year. But unless the circumstances are similar in future years, rates of fertilization suggested may not maximize profit.

Microfilm \$2.00; Xerox \$5.80. 120 pages.

EVALUATION OF PRODUCTION CONTROL POLICIES WITH RESPECT TO AGRICULTURAL ADJUSTMENT

(L. C. Card No. Mic 59-2420)

Arnold Allen Paulsen, Ph.D.
Iowa State College, 1959

Supervisor: Earl O. Heady

Corn and feed grain production control programs are investigated as to their potential effects on the organization of typical farms. Farms typical of three economic sub-regions, namely 71, 85 and 86, each including part of Iowa were selected and studied. Each farm was planned by linear programming to maximize profit when not in compliance with any program and when in compliance with each of several alternative types of production control programs. The capacity of alternative production control programs to influence farm production, resource use and income was estimated from the changes in profit maximizing farm plans.

From the analysis it appears that voluntary allotment and price support programs even with supplementary land renting features probably cannot be expected to control effectively production of feed grains. Prices of feed grains cannot be supported high enough relative to livestock prices

to induce compliance. Support prices above free market levels encourage the use of more capital and labor in feed grain production, thus nullifying potential production control. These programs do not facilitate the adjustments of the agricultural industry toward a resource balance.

The whole farm rental program could control production if the rates were competitive with other rental opportunities. It would facilitate mobility and directly increase the income of owner operators renting out their farms. To secure whole farms prospective tenants and purchasers of land for farm enlargement would have to outbid. Opportunities of these people to adjust to advances in technology through increasing farm size would be decreased by a whole farm rental program.

The rental of partial farms would also control production and facilitate farm consolidation. In areas where very productive soil occurs in combination with less productive soil a partial farm rental program would make better use of land resources and be less expensive than a whole farm program. This type of program would reduce the intensity of cropping systems more effectively than the pricing mechanism at times of low product prices.

The cost per bushel of production control was calculated for each level of payment for the land renting programs. It is evident from the analysis that the allocation of funds among regions and the rental rates set for specific soil types would influence substantially the cost of obtaining a given reduction in grain production.

Microfilm \$2.85; Xerox \$9.80. 218 pages.

SOME EFFECTS OF FEDERAL GRAIN PROGRAMS ON COUNTRY ELEVATORS IN IOWA

(L. C. Card No. Mic 59-2423)

Allen Baker Richards, Ph.D.
Iowa State College, 1959

Supervisor: Geoffrey S. Shepherd

This study was concerned with examining the effects of federal grain programs on country elevator operations. The federal programs which may influence country elevators are: (a) the occupancy contract programs; (b) the accelerated amortization program; (c) storage and handling agreements; (d) the financial aid program; (e) farm commodity loan program; and (f) the production control programs.

Data from two samples of country elevators were examined. The first was a sample of all country elevators in Iowa. The second was a sample of cooperative elevators. Most of the analysis was based on cooperative elevator data. The cooperative elevators were separated into four groups according to their total grain storage capacity. Most of the data were obtained for a 30 year period, 1926 to 1956. The 30 year period was broken into six sub-periods.

After 1946, all of the flat capacity and 76 percent of the permanent elevator capacity of cooperative elevators was built for grain storage and in response to government programs. The large elevators constructed most of the permanent elevator capacity. The small elevators built proportionately more flat capacity.

Average total investment in fixed resources for the cooperative elevators rose steadily between 1920 and 1956. After 1946, it rose at an increasing rate. The federal programs promoted and emphasized the maintenance of a high proportion of total investment in resources devoted to grain handling and storage, particularly by large elevators. Apparently, the large elevators expected the federal programs to continue and the volume of free grain for merchandising and storage to increase. Small cooperatives were either more cautious in their expectations or foresaw less prospect of increased grain opportunities in the future.

There was little change in the relationship among cooperative groups in the volume of grain handled in the 1950-56 period when government programs were in effect as compared with the previous periods when most of the programs were not in effect. However, in post-war years, three of the four groups experienced a decline in their corn volume. This was due in large part to the commodity loan program.

Inventories of CCC grain generally rose in the third and fourth quarters of each year and then dropped off in the first half of the following year. The seasonal pattern of shipments of CCC grain was inversely related to seasonal movement of CCC corn inventory.

The major difference among the cooperative groups in total gross income in recent years was the difference in income from grain, principally income from the storage of CCC and private grain. In almost every period the small cooperative elevators had about the same or greater net return on total investment in all fixed resources as the large elevators.

In the cooperative managers' opinions, the major effects of the government programs were (a) the stimulation of investment in physical equipment and buildings and (b) the alteration of the market and pricing structure facing the individual elevators.

The major implication of the study is that the federal programs accelerated the time rate of: (a) expansion of elevator operations in all major activities; (b) change in relative importance of the different activities; and (c) capital investment in all types of resources, particularly grain storage resources.

Microfilm \$3.20; Xerox \$10.80. 245 pages.

ECONOMICS, COMMERCE — BUSINESS

AN ANALYSIS OF ELIZUR WRIGHT'S LIFE INSURANCE REFORMS

(L. C. Card No. Mic 59-2239)

David Brown Houston, Ph.D.
University of Pennsylvania, 1959

Supervisor: Murray G. Murphey

Two of the most important attributes of modern life insurance are its security and the presence of living benefits as well as death benefits. One of the necessary conditions of the safety of benefits is reserve valuation, and a necessary condition of living benefits or cash values is

the recognition of the policyholder's right to his share of the reserve.

Today, all insurance companies in the United States are legally obligated to determine and maintain reserves and to grant surrender values in their policies. In 1957 life insurance companies in this country valued policy reserves at 84 billion dollars and surrender values paid to American policyholders were 1.3 billion dollars.

The existence of adequate policy reserves and equitable surrender values is, in large part, the result of the work of one nineteenth century American, Elizur Wright. The purpose of this dissertation is to study the modifications in insurance statutes and company practice brought about primarily through his efforts and the effect of these changes on the life insurance product.

A biographical sketch of Wright's life, with particular emphasis on those elements in his environment and personality which encouraged a career of life insurance reform, is included as background information. In addition a latitudinal study of the life insurance industry in the United States in 1850 is presented to indicate the nature of the business when Wright began his reforms. The core of the dissertation is an analysis, in historical and actuarial terms, of Wright's work. This includes an examination of the following areas: 1) the establishment of a legal reserve; 2) surrender values; 3) assessment of expenses; 4) the premium note system; 5) distribution of surplus; 6) American tontine policies; 7) stock vs mutual insurance companies; 8) federal vs state regulation of insurance. Finally an attempt is made to evaluate the impact of Wright's reforms on the legal structure and on company practice.

The results indicate that Wright's basic ideas have been embodied in the legal reserve and non-forfeiture requirements of all states. Company practice in nearly all cases follows the conservative reserving procedures advocated by Wright. A statistical analysis indicates that surrender values paid to American policyholders have been steadily liberalized during the past century, a trend which owes at least its original impetus to Wright.

Microfilm \$2.20; Xerox \$7.60. 165 pages.

THE LABOR PROBLEM IN INDUSTRIALIZATION IN EGYPT: A CASE STUDY

(L. C. Card No. Mic 59-1554)

I. Abdelkader Ibrahim, Ph.D.
Princeton University, 1957

In a predominantly agrarian society such as Egypt, with about 70 per cent of the labor force engaged in agriculture and the population increasing at a rate of a little more than 2 per cent a year, without a corresponding increase in cultivatable area or in agricultural productivity, industrialization is thought of as the panacea for many of the socio-economic problems of the country. Granted that problems related to capital formation, which are of great magnitude, could be solved to a reasonable degree, either by means of local or foreign capital or a combination of both, what are some of the structural aspects in the Egyptian society which are dysfunctional to industrialization? What are the functional and structural requisites which accelerate this process?

The research design of this dissertation is primarily exploratory and descriptive in nature of the problems faced by Egyptian management in the process of industrialization. So far there has been a deliberate effort to copy western models and techniques of industrialization in Egypt. There has been no indication that this process has been selective; on the contrary, every observation leads one to think that this is not the case. Industry has emphasized the importance of securing the latest modern technology, including technical know-how, but has not planned or been concerned with the type of social conditions which would be advantageous to industrialization. Even programs of housing, recreation, and health, which might be called social engineering, have been provided in such a way that no transition is afforded from the previous environment. There has been no attempt to integrate the industrial establishments with the larger communities in which they are located, and high walls often completely isolate them. There have also been insufficient attempts to educate the members of the administrative organization or the workers to utilize the available new social resources to best advantage.

The following is a list of some of the areas investigated:

1. Entrepreneurship and Management.
2. Recruitment and Commitment of an Industrial Labor Force.
3. Institutions of the Development of Manpower Resources.

The model of rational bureaucracy with its major specifications will be considered:

1. Specific, limited, hierarchized objectives.
2. Prescribed rational orientation in the use of scarce resources for achievement of objectives.
3. Relationships are normatively formalized and routinized, which serves to: insure predictability; allocate activities according to spheres of competence; allocate personnel according to merit; and depersonalize relationships and insure continuity with personnel turnover.

This model was used as a basis for the investigation and analysis of the organizational structure of the fifty-eight industrial establishments which are the subject of this dissertation. These establishments were divided into four types. It was found that the foreign owned and managed companies more closely approximated the model than any of the other types discussed.

In a country which is predominantly agricultural and where social actions are predominantly based on traditions, management may at least in the early stages of industrialization find it more effective to operate the organization taking into account a great portion of the traditional aspects of behavior, rather than on a purely rational basis.

This poses the question of whether the model of rational organization is adequate for the understanding and interpretation of the process of industrialization in underdeveloped areas.

The main conclusions discussed in the last chapter do not suggest that Egypt's case is unique. It is necessary, in the opinion of the writer, that these problems in Egypt be compared with similar or contrasting ones in other underdeveloped areas which are also undergoing the process of industrialization and social change.

Microfilm \$3.10; Xerox \$10.60. 238 pages.

SAVINGS BANK LIFE INSURANCE

(L. C. Card No. Mic 59-2241)

Donald Robert Johnson, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Dan M. McGill

Despite the fact that savings bank life insurance has been in effect for more than fifty years, and the fact that the three state systems, Massachusetts, New York, and Connecticut, have a combined total of more than one billion dollars of life insurance in force, little is known about the background and origin of the individual state movement, the organization of the three systems, and the functioning of the general program. For these reasons, it is the purpose of this dissertation to describe, analyze, and evaluate the entire savings bank life insurance movement.

Because of the scarcity of material that describes the workings of the savings bank life insurance program, the basic procedure or method employed was that of the personal interview. This necessitated a considerable amount of consultation with the personnel at the central administrative body of each state system in order to secure the necessary material. Very little information, other than some of the historical data, is from secondary sources.

The study is divided into four distinct sections. Part I is historical and develops the events that led to the passage of the necessary legislation in the three savings bank life insurance states. Part II describes the organization of the program. Part III discusses the operational aspect of the program, including policies, promotion of the systems, premium and dividend computations, and growth of the program. Part IV is devoted to a summation and critique of the movement.

A number of conclusions have been drawn from this study, the most important of which are: (1) the program has strayed from its original intent to supplant industrial life insurance; (2) if all manner of subsidy is eliminated, the systems should be free to write life insurance without restrictions as to policy limits; (3) the program in each of the three states is financially sound; (4) in general, net cost is very favorable; (5) it should be recognized that such an over-the-counter system of marketing life insurance suffers the loss of the valuable services rendered the policyholder by the competent life agent; (6) the savings bank life insurance movement has experienced an almost uniform rate of growth; and, (7) as of the data of this study, there is no serious attempt to spread the movement to any other state. The systems have found, generally, that the old adage that "life insurance is sold, it is not bought" is still true. Microfilm \$4.95; Xerox \$16.60. 386 pages.

THE APPLICATION OF THE PRINCIPLES
OF COMMUNICATION TO THE PROBLEM OF POLICY
FORMULATION IN ADMINISTRATIVE COMMITTEES

(L. C. Card No. Mic 59-2286)

David Tsevi Kleinman, Ph.D.
The Ohio State University, 1953

PURPOSE OF THE STUDY

The general purpose of the dissertation is to discuss the communication process within policy-formulating administrative committees. The specific purpose is to investigate what other scientific disciplines such as general semantics, psychology, sociology, and social psychology can add to the understanding of the effective operation of the committee. An attempt is made to apply the results of theoretical and experimental work done in other social disciplines to the understanding of communication in managerial committees.

The dissertation is also a discussion of group decision-making. Even though the emphasis is placed on the communication aspects of group decision making, some attention is also given to the logical implications of the problem.

SCOPE AND DELIMITATIONS OF THE SUBJECT

The following is a summary of the scope and delimitations of the subjects:

First, the discussion is primarily concerned with business and industrial committees. The conclusions reached are intended to improve the effectiveness of business committees, but they may perhaps be valid in the case of committees of other organizations.

Second, only intramanagement communication is considered. Only committees composed of members of the management group are considered. The discussion does not cover committees with members from such groups as employees, customers, and suppliers.

Third, only administrative management is covered in the discussion. This work concentrates on the problem of communication within committees the members of which belong to top management. It is not concerned primarily with communication in committees used by operative management, even though much of what is said here may perhaps apply to such committees.

Fourth, the discussion is limited to communication in the formulation of policy. The process of communication in committees is analyzed only in reference to the function of formulation of policy, even though some of the analysis may perhaps also apply to committees which perform other functions than policy formulation.

Fifth, only oral face-to-face communication is discussed. Other means of communication among members is not covered. Members of a committee may correspond with each other, or they may use a multi-line long distance telephone hookup, for instance. Such means of communication, however, are not covered in this project.

Sixth, available material from other social sciences is used. As much material as possible has been drawn from the various social sciences concerned with the problem of the communication process within committees which formulate policies. Material collected from psychology, sociology, social-psychology and the other social sciences is treated, however, from the point of view of a management

student rather than a professional psychologist, sociologist, or social-psychologist.

Seventh, the committees that are explored are those with bona fide staff authority to formulate policy. The communication process of committees studied is that associated with the problem of policy formulation by a committee with staff authority to arrive at a decision which, in the committee's collective opinion, is superior to any alternative decisions. Committees constituted with the purpose in mind to acquaint subordinates with decisions which the chairman, or any other member, has already agreed to, are not discussed.

Eighth, only legislative and integrative committees are discussed. Investigational and analytical committees, as well as educational and judicial ones, will be omitted. The delimitation is imposed because only legislative and integrative committees can lead to a decision of a policy nature.

METHOD USED

This study is based for the most part upon library research. The field of communication has recently become a subject of major interest to many disciplines and the literature that is available in this area is very rich.

The literature on communication that is available in the field of management and in the various social sciences is reviewed.

The review of the subject of communication in the literature of the field of management reveals the general nature of the problems of communication that perplex individuals engaged in managerial work.

With this background of what managers perceive as the major communication problems in the co-ordination of thought and action, the literature of the various social sciences is surveyed for the purpose of finding material which may contribute to our understanding of communication in general and of communication in committees in particular.

The subject logically divides into three major parts: (1) the communication process; (2) formulation of policy; and (3) the committee as a technique in policy formulation.

It is clear that communication within committees has common elements which are unique to institutions composed of small groups of individuals. However, there is no doubt whatsoever that communication within committees has many common elements with communication in other forums.

Part One, "About the Communication Process," is devoted to a discussion of those elements of communication in committees pertinent to other situations as well but indispensable to the understanding of the process of communication in committees. This relationship was pointed out throughout the discussion. It is hoped that this part provides the background necessary to the understanding of the process of communication in committees. Part One contains brief discussions of communication from the standpoint of philosophy, psychology, and general semantics. It has a discussion of communication from the standpoint of management. It also discusses communication as the basic, social process of a business committee, which deals with the social-psychological aspects of communication.

Part Two, "About Formulation of Policy," is concerned with the problem of formulation of policy as it affects the communication process. Since this project is concerned with the problem of communication in the formulation of

policy, it seems necessary to investigate briefly the whole subject of policy so that an idea about what is being communicated may be obtained. Part Two deals with the nature and characteristics of business policy in general, and the phase of policy formulation in particular.

Part Three, "The Committee as a Technique in Policy Formulation," is concerned exclusively with the problem of communication in committees. It deals with those aspects of communication characteristic of small groups only. Part Three is devoted to the analysis of the business committee as a technique in the formulation of policy. It evaluates available material dealing specifically with the subject of communication in committees. It begins with a brief discussion of the general organization of the business committee, and proceeds to review experimental studies that have been done in allied social sciences such as psychology, sociology, and social-psychology. The experiments reviewed in this part are those whose results have a pertinent bearing upon the understanding of the process of communication in the formulation of policy in business committees. All of the reports reviewed are of controlled experiments. The results of these experimental studies provide the background for an analysis and evaluation of the effectiveness of the committee as a technique of communication in the formulation of policy. Each experiment is analyzed and evaluated, the applicability of the conclusions reached from such experiments is estimated, and in the light of these conclusions, changes in present practices of business committees are recommended.

SOME SUGGESTIONS FOR IMPROVEMENT OF COMMITTEE OPERATION

This study has surveyed the various social sciences with the purpose in mind of gathering available material in these disciplines which may be of help in the understanding of the process of communication in administrative committees. Some of the material found in these sciences has not been available in management literature. Other material has been recognized by management students. In the latter case, the significance of the results gathered from the various social sciences lies in the fact that they have confirmed ideas and notions of management students through controlled experimentation and thus transferred what might have been considered "systematic" knowledge of management to the "scientific" category. The latter refers to knowledge obtained through the use of rational analysis and controlled experimentation as the chief tools in obtaining the best possible results concerning management problems.

The following are some of the major conclusions brought out in the study. They offer some suggestions for improvement in the communication process of policy formulating committees.

First, a sound philosophy of communication may be very helpful. Committee members may find it valuable to have a general knowledge of the nature of language, the limitations of language, some errors in assumptions about the use of language, the functions of signs and symbols, the meaning of meaning, and other such concepts.

Second, members should become acquainted with the principles of general semantics and their application. Formal training in general semantics may be worthwhile for executives that spend a great proportion of their time in committee meetings and conferences.

Third, to be an effective communicator in a committee meeting, one should learn to perform a number of tasks successfully. Some of these tasks involve ascertaining the true intent of the message to be conveyed, deciding the desirable effects of the communique, determining the "image" of the communicants, knowing the specific elements of a situation to which the communicants may pay attention to the neglect of other elements, and recognizing the mood and ethnocentric tendencies of the communicants. Some competence in the performance of these tasks may be achieved by a special training program under the supervision of a qualified social scientist.

Fourth, to be an effective communicant in a committee meeting, one should pay attention to a number of factors. Some of these involve ascertaining the intent of the speaking committeeman, knowing the total context of the situation, having an "image" of the communicator, and recognizing one's own frame of reference as well as that of the communicator. Barriers to communication in general may be overcome by constant awareness of what the major obstacles to smooth communication are, and by maintaining a spirit of watchfulness for these obstacles in the course of the communication process.

Fifth, the committee should attempt to reach integration of ideas whenever possible. Some compromise may however be necessary in some cases, and may give good results.

Sixth, members should attempt to offer an optimum amount of information to the committee. The information offered should be neither too detailed nor too general. If it is less than this optimum, the conclusions reached may not be valuable at all; if it is more than necessary, the members may be flooded with impertinent details which may only interfere with their effective thinking.

Seventh, committee meetings are an effective means of automatic indoctrination of the participants in a common system of goals, values, and beliefs in general. This allows members to be self-coordinated when the situation so warrants. Communication in committees serves to acquaint executives with the "strategies" of their colleagues, so that when they must make a decision which requires knowledge of what other participants would do, they can proceed without hesitation.

Eighth, participation should be spread as equally as possible among all members. The committee should not be dominated by one individual or any combination of a number of members. A policy decision should be reached only after full participation of all members has been encouraged. All members should be allowed and urged to suggest possible solutions and to contribute all they can to the understanding of the problems discussed.

Ninth, to achieve effective communication, satisfactory human relations among members must exist, and the group must be as cohesive as possible. Mutual confidence and trust are absolutely essential for effective communication. Similarly, the more cohesive the group (cohesiveness refers to the extent to which members like each other and the group as a whole, and want to remain a part thereof), the more effective and efficient the communication process. It is not sufficient for the members to belong to the committee formally. They must also belong to the "psychological group."

Tenth, the status of the participants in committee discussions affects the communication process. Every communique should be transmitted with due regard to the status

of the prospective recipient. In general, the status of the communicator determines the authenticity, authoritative-ness, and intelligibility of messages. Differentials in hierarchical statuses should not interfere with the smooth flow of the communication process. Members should be aware of the tendency of those who belong to a higher hierarchical position to communicate among themselves, and of those of lower status to address their communiqués to the higher status members. Status should not be the determinant of who speaks to whom. It is rather the relevance of the comment to the views expressed by each member that should determine the who-to-whom matrix.

Eleventh, the committee members should attempt to reduce the influence of sentiments upon the communication process. The discussion should be as logical as possible.

Twelfth, committee members should make sure that discussion in the committee proceeds in the right "direction." Members must always correct their colleagues when it seems to them that the latter are thinking in the wrong "direction." Before proceeding with the consideration of an alternative policy, all members must agree that the general direction of the discussion is correct.

Thirteenth, an atmosphere of complete cooperation among all members should prevail all the time. The members must co-operate to the utmost and attempt to aid each other in offering suggestions, correcting others' errors of thinking, and agreeing with suggestions made by others which appear logical to them. A spirit of competition among committeemen is most detrimental to the achievement of good results.

Fourteenth, no important policies should be decided immediately after the formation of a committee. The members of a committee must be allowed sufficient time to reach a common system of values, beliefs, or goals.

Fifteenth, the leadership of a committee should be as democratic as possible. The leader should not dominate the committee, and he should try to spread participation as much as possible. The degree of dominance of the leader of the group is the most important element determining such factors as total activity, satisfaction of the members, and the organization and procedure of the committee. The leader should attempt to upgrade the quality of the committee's work. This he should do by allowing members with minority views to present their arguments to the entire group by preventing the majority group from exerting social pressure upon the minority to change sides. The leader should determine the subject for discussion, state the problem in constructive terms, and ask exploratory and stimulating questions.

Sixteenth, members must always maintain a perceptive mind for any information which may change their opinions. Communication becomes valueless when members refuse to be influenced by others' opinions. A willingness to be influenced by pertinent, valid, and true information is facilitated by the members' desire to continue the operation of the committee and make sure that the communication process carried on in it is effective and efficient.

Seventeenth, the committee must first decide upon the objective that the discussed policy must accomplish. The first thing that the committee must do before discussing any details of the policy is to clarify for itself the objectives which the proposed policy is to serve. All members must have exactly the same objective in mind. The problem must also be checked against reality.

Eighteenth, the committee must then decide whether

it is the right forum for the consideration of the problem-
atic policy. This is determined by the consideration of
such points as the following: whether a new policy is es-
sential; whether there is already a policy which covers
the problem; whether it would not be premature to formu-
late the policy now; whether the policy is pertinent to the
prevailing conditions; whether this specific committee
should handle the policy problem or another one is better
qualified to formulate it; whether it would not be better
if the line executive should decree this specific policy;
whether the situation is such that there is sufficient time
for a committee to convene and discuss the problem; and
whether the committee has sufficient information on which
to make an intelligent decision.

Nineteenth, the committee then analyzes the functions
necessary to reach the objective.

Twentieth, the committee should then select the prin-
ciples and rules of action that will link the functions with
the objective. The committee must select the policy whose
consequences are preferable to those of all alternative
policies.

Twenty-first, the committee should only be assigned
the formulation of policies which involve the solutions of
very difficult and complex problems. Easy and local pol-
icy problems may be left for decision to the individual in
charge.

Twenty-second, only topics about which there is dis-
agreement and which are relevant to the work of the mem-
bers should be brought to the committee's attention. If
possible, the members should find out at an early stage
just what discrepancies do exist in their views.

Twenty-third, the techniques of role-playing and self-
evaluation should be used as training devices for improving
the productivity of the committee's work whenever possible.

THE SIGNIFICANCE OF THIS STUDY WITH RESPECT TO THE FIELD OF MANAGEMENT

An attempt has been made in this study to draw as heav-
ily as possible from available material on communication
in the various social sciences which bear on the subject
of communication in policy formulating administrative
committees. On the basis of this study some recommen-
dations have been offered which may aid in improving the
effectiveness and efficiency of the committee technique.

One of the basic premises of this project is that stu-
dents of management should apply knowledge accumulated
from the various social sciences to current management
problems. The various social sciences have arrived at
some basic knowledge about communication in general and
in small groups. As much material as possible has been
collected from the various social disciplines, and it has
been applied to the understanding of communication in
committees. Microfilm \$4.30; Xerox \$14.40. 335 pages.

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THE SMALL SHIPMENT PROBLEM

(L. C. Card No. Mic 59-2255)

Sidney Lincoln Miller, Jr., Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Joseph R. Rose

Statement of the Problem

One of the most troublesome and controversial trans-
portation problems for users, carriers, and government
is the small shipment problem. The purpose of this dis-
sertation is to analyze small shipment services critically
by considering organization, traffic, nature of the services,
rates, cost, competition and cooperation, markets, and
public policy. The objectives include identification of fac-
tors which cause the problem and recommendations to im-
prove efficiency, service, and rates.

Method

The method of analysis is largely empirical. Consid-
erable use is made of economic and legal principles. Case
and statistical studies appearing in government documents,
industry reports, and trade journals are employed exten-
sively. The studies are supplemented by field trips
and personal interviews with carrier and shipper repre-
sentatives.

Results

Small shipments consist primarily of manufactured
goods, which vary considerably in weight and distance
transported. Small shipments move in substantial and in-
creasing volume largely between a limited number of points.

Services for small shipments are provided directly and
indirectly by regulated, exempt, and private carriers. The
services involve principally assembling, concentrating,
inter-terminal movement of bulk, separating and distribut-
ing. Qualitative differences in performance of these proc-
esses are attributable primarily to volume of traffic and
to equipment employed.

Small shipment services are adequate quantitatively
and qualitatively, small towns excepted. Cost of service,
however, is needlessly high because of excess capacity,
uneconomical methods, duplication of effort, and failure
to allocate tasks according to inherent advantages of the
several types of transportation. There is considerable
criticism of the spiraling level and distorted structure of
rates, the former resulting in large measure from inef-
ficiencies and the latter from demand pricing.

Improvements in efficiency and in the level and struc-
ture of rates can be accomplished only through substantial
reorganization of the transport industries and more effec-
tive working of the price mechanism. Changes of this type
and magnitude are discouraged by public policy.

Conclusions

In the short run, it is suggested that the most obvious
difficulties be alleviated by extending multiple weight
groupings and charges, developing more institutions and
better techniques for concentrating small shipments, pool-
ing of traffic among railroads, extending rail and ship
trailer services, and relating inter-agency competitive
rates to the relative cost of handling the several weight
and distance groups.

Long range recommendations proceed from a general

and defensible public objective, that is, transport coordination. Coordination involves many problems common to small shipment and other services. The recommendations include reorganization of Federal independent and executive agencies, imposition of user charges, rationalization of transport, and relaxation in control of transportation organization, operating authority, and competitive rates.

Microfilm \$4.20; Xerox \$14.20. 326 pages.

THE VESTING OF PRIVATE PENSIONS

(L. C. Card No. Mic 59-2257)

Jonas Earl Mittelman, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Dan M. McGill

The recent surge in the private pension movement has given rise to a number of complex issues. One of the foremost problems, for which a satisfactory solution has been elusive, is whether or not to provide for the vesting of benefit accruals. The question is complicated by the necessity of selecting an appropriate type of vesting if a decision is made to include a vesting provision in the plan. The economic and sociological impact of private pensions upon millions of employees and their employers underscores the need for an early solution of this problem. The present work represents an effort to provide pension designers and others with information which may assist them in their quest for answers to this issue.

Because vesting is but one segment of the broader topic of pensions in general, this work briefly reviews industrial pension history, with emphasis on the developmental factors relating to vesting. Also, the various philosophies underlying past and present pension plans are critically examined to ascertain whether or not such philosophies may support or negate the adoption of particular vesting provisions.

Available statistics are presented to indicate the extent of vesting adoptions in contemporary pension plans as well as the frequencies with which different types of vesting provisions occur. The principles and practices of vesting are appraised and criticized.

Since the cost of vesting was cited most frequently by interested persons as being the greatest deterrent to wider vesting adoptions, this aspect of the problem receives a considerable amount of attention in this work. Prospective and retrospective methods of estimating such costs are discussed and the nature of the data needed for such estimates is indicated. Inherent shortcomings of both approaches are pointed out.

The unavailability of empirical vesting cost figures led to the undertaking of a special investigation by the author in order to compile a sample of experience data which would depict such actual or potential costs. The experience of nineteen business firms is reflected in the study which covers periods of two to five recent years and includes approximately 100,000 pension plan members. For those firms whose plans include vesting provisions, estimates of their actual current costs are given. For all of the firms, estimates of potential current vesting costs are presented on the basis of vesting by service

requirements for periods of 5, 10, 15 and 20 years. In addition, estimates are given for vesting by combinations of age and service requirements for the quinquennial ages of 40, 45, 50 and 55, combined with service periods of 5, 10, 15 and 20 years. The vesting cost approximations are exhibited in an elaborate set of tables depicting the firms' actual annual labor turnover for quinquennial age groups, by sex and by durations of service; cost rates are likewise shown within the same classifications.

The study as a whole permits several conclusions to be drawn. A few may be mentioned. First, the profusion of vesting provisions adds to the complexity of pension issues. The number of different types of provisions may be reduced without doing violence to underlying costs or supporting philosophies. Second, vesting should be conferred, generally, only after a period of service of sufficient duration to accumulate a meaningful benefit. Finally, based upon the experience of the firms included in the sample study, relative vesting costs related to service requirements generally are moderately low, although considerable variation exists among different companies and in different periods of time. Microfilm \$2.85; Xerox \$9.80. 219 pages.

AN ANALYSIS OF CORPORATE CONCENTRATION IN RETAILING

(L. C. Card No. Mic 59-2303)

John Kerch Pfahl, Ph.D.
The Ohio State University, 1953

Concentration of economic power has been widely recognized and studied as one of the major social problems emerging from the Industrial Revolution. Despite the fact that manufacturing, mining, and agricultural resources in a modern complex society are useless without a dynamic system of distribution, a careful analysis of earlier studies in economic concentration demonstrates that they have been primarily concerned with manufacturing. A need, therefore, exists for careful analysis of the extent and effects of concentration in the distributive trades. The study was undertaken to measure and analyze the extent, nature, trends, and effects of corporate concentration in retailing and to test the hypothesis that retailing is the stronghold of small business in the United States and that it is an area of little concentration.

Basic Concepts and Research Methods

Concentration is defined as the gathering of economic control into one corporate body. This simply means the extent to which the total volume of retail sales is channeled through a small number of outlets, either as retail outlets or as corporate organizations of retail outlets. Concentration is discussed mainly in terms of the latter and may be described as the percentage distribution of sales according to size of organization.

An important distinction must be drawn between the size of an enterprise and the amount of control concentrated in it. Small firms may possess concentrated power in limited markets. In extensive markets, such power may be beyond the reach of very large concerns. Absolute size is not synonymous with concentration. Size in relation to

the industry or market is important in studying concentration if that relative size is sufficient to exert some control over other organizations in the same market.

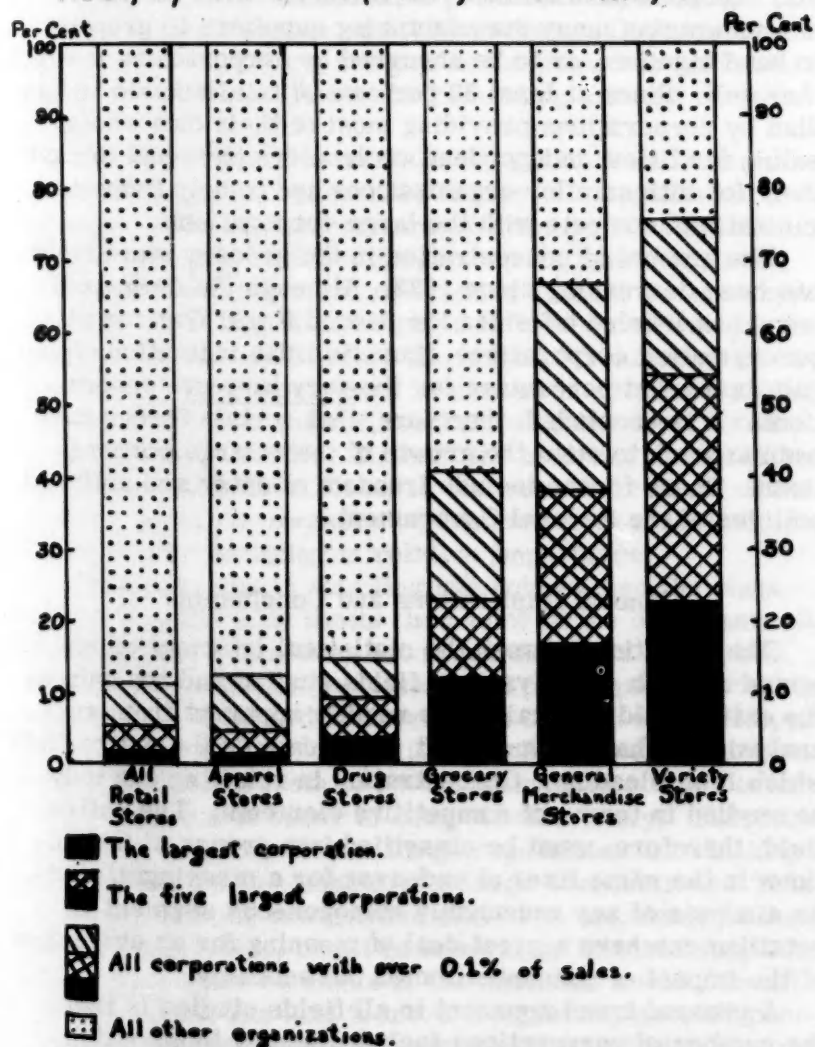
A criterion for determining the extent of concentration is a prerequisite to any analysis of corporate concentration. After consideration of all pertinent criteria, volume of sales has been chosen as the base for measurement in the retail field because it is directly related to the amount of influence a corporation exerts on the consuming public as well as on competitors and suppliers. Sales volume of each large corporation is related to total sales of all retail stores in the various fields of study; any corporation handling more than one-tenth of one per cent of total retail store volume in any field is included among those corporations which foster concentration.

Instruments of concentration existing outside the corporate structure, such as interlocking directorates, trade associations, and voting trusts, are beyond the scope of the study but should be kept in mind when appraising the evidence presented. No attempt has been made to go outside the field of economics; hence, sociological and political effects of corporate concentration are not treated.

Data for the study were obtained primarily from

Chart 1

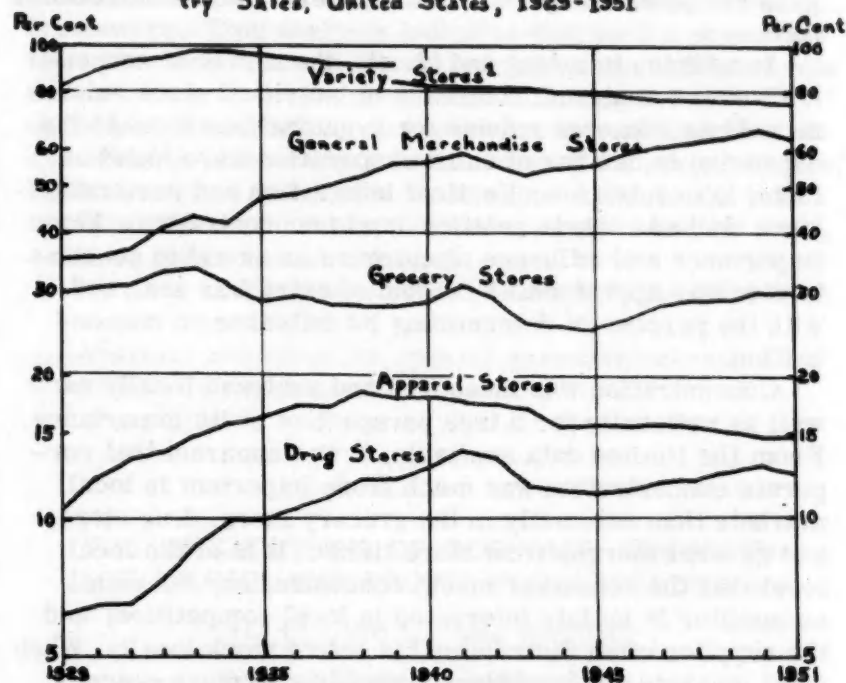
Per Cent of Sales in All Retailing and in Selected Fields, By Size of Corporation, United States, 1950.



Source: Tables 7, 14, 20, 27, and 32 of Dissertation.

Chart 2.

Per Cent of Total Industry Sales in Selected Retailing Fields by All Corporations Handling Over 0.1% of Industry Sales, United States, 1929-1951



1. Change in definition in 1930.

Source: Charts 3, 8, 13, 18, and 22 of Dissertation.

Securities and Exchange Commission Registration Statements and Quarterly and Annual Reports, Moody's Manuals of Investments, Standard and Poor Corporation Statistics, various corporation annual reports, government publications, and periodicals. Monographs of the Temporary National Economic Committee were particularly helpful in designing an approach and in providing background material.

In measuring and analyzing concentration, particular attention was devoted to effects on consumers, competitors, and suppliers. Because of their importance, five segments of the retailing structure which together account for one-half of total retail sales were singled out for special study: (1) grocery stores; (2) variety stores; (3) drug stores; (4) apparel stores; and (5) general merchandise stores. Concentration in each of these fields from 1929 to 1951 was analyzed in detail.

The extent of corporate concentration in retailing and in each of the five segments is indicated in Chart 1. For each field, the per cent of total sales accounted for by the largest, by the five largest, by all corporations handling over one-tenth of one per cent of sales, and by all smaller organizations is graphically presented. The wide variation between fields is readily apparent, indicating the importance of studying each field separately. Although retailing appears to be relatively free of concentration if all fields are combined, it is apparent that certain fields are characterized as highly concentrated when considered separately.

A summary of the trends in concentration in the specific fields of study is presented in Chart 2. A striking variation in pattern between the various fields during the period of study is apparent. Concentration has continued to gain in importance in the general merchandise store field while decreasing in importance in other areas. Concentration

reached its peak in the variety store and grocery store fields in 1933, in the apparel store field in 1938, in the drug store field in 1941, and had apparently not gained its greatest potential by 1951 in the general merchandise store field.

In addition to extent and trends, the nature of concentration was analyzed. Increase in individual store volume as well as enhanced volume for organizations through the expansion in number of units in operation were found to foster concentration. Vertical integration and penetration were studied in their relationship to concentration. The importance and influence of mergers as an aid to concentration was appraised. Freedom of entry was analyzed with the purpose of determining its influence on concentration.

Concentration was measured and analyzed locally as well as nationally for a true perspective of its importance. From the limited data available, it was apparent that corporate concentration was much more important in local markets than nationally in the grocery store, drug store, and general merchandise store fields. It is at the local level that the consumer meets concentration; the small competitor is mainly interested in local competition; and the supplier often distributes his entire stock locally. When local markets are considered, retailing is more concentrated than indicated by national analysis.

Corporate Concentration in Grocery Store Retailing

All five lines of trade were studied in the same manner, although conclusions necessarily varied with the field of study. As an example, the following summary of the grocery store field is presented.

Nature of concentration.--Concentration has developed through two distinct channels: (1) individual stores have grown in size so that they each handle a greater percentage of the volume; and (2) corporate chain organizations have grown in number of outlets. These developments mean that fewer stores and even fewer organizations are needed to handle an equivalent volume of merchandise than was true in 1929. From 1929 to 1951, the largest corporations utilized the first method of growth to a much greater extent than the second. The emergence of supermarkets and the widening of lines handled by them has made growth in volume of individual stores a very important factor in concentration since 1933. Vertical integration has also been important in the growth of the largest corporations while penetration has had little effect. All of the twenty-six largest corporations in 1950 maintained some wholesaling facilities and many also manufactured some of the products sold.

Extent of concentration.--The largest corporation accounted for 12.0 per cent of sales in 1950. The three largest together handled 19.5 per cent, all corporations each accounting for more than one-tenth of one per cent of sales handled 30.0 per cent and the remaining 350,000 organizations handled 69.7 per cent.

Trends in concentration.--Neither the largest nor the five largest corporations combined have shown any propensity to expand their share of the market since 1933. All concentrating corporations together, however, have expanded their share since 1945. It is the second size level firms which have gained in importance at the expense of the largest corporations. Independent grocery stores

have maintained their portion of the market at a fairly steady level since 1929.

Local concentration.--Many relatively unimportant firms nationally were found to be the most important corporations in their respective local markets. This is significant since grocery store retailing is a relatively local business. Although only six corporations each handled more than one per cent of sales nationally, a considerable number of corporations each accounted for more than one per cent of the volume in the areas in which they operated. Since very few corporations were national in operation, local analysis presented a wide variation from national analysis.

Effects of concentration.--Because of relatively easy entry, concentration has not taken away consumers' freedom of choice. Vast numbers of small organizations are still in operation and have shown little inclination to give way to large corporations. It is competitors and suppliers who have felt the greatest effects of concentration. Competitors have been forced to change techniques and methods and in some cases to band together into new corporate or voluntary organizations to compete with large scale corporations. Suppliers in many cases have seemingly been at the mercy of large organizations. When one corporation handles twelve per cent of total national volume, as the largest one actually did, that corporation becomes extremely important to suppliers in the field; it thereby gains unequal bargaining power. Concentration has had the effect of withdrawing a portion of the market from regular independent wholesalers. It has also had the effect of encouraging many manufacturing suppliers to grow large, to band together, or to be absorbed by corporations to which they sell. Since at least 30 per cent of total volume is handled by corporations providing most of their own wholesaling facilities, independent wholesalers have had to cast their lot with smaller organizations and to help those organizations compete with the large corporations.

The amount of concentration in the grocery store field has been decreasing since 1933. Although the downward trend has leveled off since the Second World War for all concentrating corporations, there is little indication of any gain in market percentage for the very largest corporations. It is concluded, therefore, that certain forces have been at work to stem the growth of these large corporations. These forces include freedom of entry and antitrust policies of the Federal Government.

General Implications and Conclusions

The variation between the statistical information obtained on each of the various fields studied and the data on the entire field of retailing is readily apparent from an analysis of Charts 1 and 2. It is the data on the entire field which is misleading. Concentration in retailing can only be studied in terms of competitive elements. The entire field, therefore, must be classified into groups of institutions in the same lines of endeavor for a meaningful study. An analysis of any reasonably homogeneous segment of retailing can have a great deal of meaning for an evaluation of the impact of concentration on the economy.

A general trend apparent in all fields studied is that the number of corporations included among those which each handle more than one-tenth of one per cent of volume in each area is increasing. More large corporations may

mean increased competition, since large firms are better able to compete with other large firms. Many economies of scale in retailing can be achieved with one hundred large corporations in each field as well as with four or five giants. Another apparent trend is that the largest corporations are better able to maintain a stable position than the smaller organizations. Because of their ability to better withstand financial losses, large corporations tend to maintain a more constant volume; thus, they gain relatively in times of economic stress, while smaller organizations absorb the additional volume in good times.

The existence and enforcement of the antitrust laws may not be the cause of the reduction in growth of the largest corporations, but the facts are clear that the largest corporations have stayed within limits since the depression years of the 1930's. Governmental action or fear of such action may well have been one of the limiting factors. Another deterrent to increased concentration is the relative freedom of entry in most retail fields. With the exception of mail order houses and department stores, the capital requirements necessary to open a new retail outlet are relatively small. This may be the reason why the general merchandise store field was the only one studied in which the growth of concentration did not appear to be checked by 1951.

Retailing is particularly susceptible to mergers because of the large number of small organizations and their relative instability. Many of the present large corporations have grown in part through merger. The disturbing element, from the competitive point of view, about the post-war increase in merger activity is the resulting decrease in the number of organizations accompanied by an increase in the relative position of the remaining merged corporations.

The existence of a number of organizations in each area of retailing with a reasonable degree of independence is necessary for the maintenance of a competitive system. Should one, two, or three large corporations completely dominate the field, more restrictive control would be necessary. Retailing is no longer a field of small enterprises only, but it has not reached the stage of domination by two or three large corporations in each area. No substantial increase in the amount of concentration has been noted since the early 1930's; instead, the tendency has been for the second size level firms to increase their share of the market while the largest corporations were merely holding their own or declining in relative importance.

Concentration in retailing has not reached the stage where it materially limits the choice of the consumer. It is important that it does not reach this point. The data analyzed lead to the conclusion that public policy or other forces have operated to prevent the breakdown of competitive influences. Concentration has directly affected competitors, forcing them to revise techniques and to become more efficient in order to compete effectively. There is evidence that nonconcentrating corporations in retailing have been able to compete with large corporations. This ability to remain competitive should be maintained. During the period studied, retail concentration affected suppliers more than other elements of the business world. Retail concentration can lead to more integration, greater penetration, and increased concentration in supplying industries.

Despite the local and national extent of concentration in retailing in 1950, there were, with few exceptions, a sufficient number of large and small firms to maintain

competition. An unrestrained merger policy may seriously change the field from its present competitive status. A countervailing power for large retail corporations is necessary if they are to continue to exist in a competitive framework. This analysis indicates that such a power has been prevalent in the field. Present governmental controls and economic checks and balances including freedom of entry have provided the necessary countervailing power to check the growth of concentration during the period covered by the study. It is felt that these same controls and balances will be sufficient to maintain competition in the retail areas in the foreseeable future.

Microfilm \$5.00; Xerox \$16.60. 390 pages.

Abstract published by special arrangement with The Ohio State University.

THE IMPLICATIONS OF ECONOMIC CONCEPTS OF INCOME AND PROFIT FOR ACCOUNTING

(L. C. Card No. Mic 59-2056)

Rudolph Walter Schattke, Ph.D.
University of Illinois, 1959

The present day emphasis in accounting on the determination of income has brought with it a deepening concern about the nature of income and the theoretical accuracy of the present concepts of income used by accountants. Since concepts of income and profit hold a prominent position in economics, accountants logically can expect some aid from discussions in economic literature. This study was a review of economic concepts of income and profit to ascertain their usefulness and applicability for accounting. Since this was neither a definitive appraisal of economic thought nor an attempt to find an economic justification for present accounting thought and practice, the various economic ideas were presented without endeavoring to cast them in a traditional accounting mold. Therefore, the arrangement of this study followed the main economic concepts, and implications of these concepts for accounting were indicated as discussion progressed.

Organization of this study was based on two important ways of looking at income and profit in economics: 1) as a return, and 2) as a difference between revenues and costs. As a preliminary to the extended discussion of these two conceptions, two other subjects were first dealt with: a) national income, and b) income and profit when used as general terms.

As the study unfolded, it became apparent that concepts of income and profit in economics are both manifold and diverse. It seemed that although there are only a few basic starting points in a study of income and profit, there have been many ramifications in the paths that have been pursued from these starting points. It is important that this diversity and the multiplicity of variations that can be found in economics be recognized by accountants. A great deal of accounting literature exhibits an unfortunate tendency to oversimplify the economic concepts; consequently accountants both lose the richness of economic thought and fail to glean as much information as is available. The diversity of economic thought is not an unmixed blessing, for it has often posed as a deterrent to those who would

find what economists think about income and profit. One cannot find any single authoritative and comprehensive economic concept; nor is there any single source of pertinent economic concepts. This study is designed to circumvent these deterrents by disclosing the diversity of economic thought and also indicating to some extent the sources of material in economic literature.

The multiplicity of economic concepts presented in this study meant a corresponding multiplicity of conclusions. These were pointed out at many places throughout the study, and cannot be recapitulated in the space available here. Suffice it to say that some of the implications are important and far-reaching.

It was not suggested that enterprises abandon their traditional financial presentations and practices, but that accountants, to be progressive, should constantly question the usefulness and relevancy of their art. An understanding of economic concepts of income and profit should be a definite aid and stimulus in this self-examination. Furthermore, as accounting theorists come to grips with problems of income and its determination in the future, a close familiarity with economic concepts should be helpful in formulating consistent and relevant concepts.

Microfilm \$4.00; Xerox \$13.60. 311 pages.

CASUALTY INSURANCE EXPERIENCE AND PROFITS

(L. C. Card No. Mic 59-2269)

Raymond George Schultz, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Clyde M. Kahler

The purpose of this dissertation is twofold: to determine the profitability of the casualty insurance industry over a representative period of time, and to study the sources of casualty profits and analyze the pros and cons of inclusion in the rate-making process of various profit formulae. The question of the propriety of such a formula, and in turn of determining a sound and equitable profit formulae is one that has been a source of continual disagreement both within the National Association of Insurance Commissioners and between it and various rate-making organizations, which in turn also differ among themselves.

The topic has been developed historically, analytically and statistically. Industry literature dating back to 1918 has been reviewed in light of the problem, and the conclusions offered by various authorities in this field have been noted. The concept of the profit factor has been studied: its nature, functions and effects. Present statutory accounting procedures have been mentioned in so far as they affect the operation of a profit factor. Data has been compiled showing the profitability of the casualty industry over a thirty year period (1926-55). These data are composed of aggregate statistics for the industry and groups of sample companies within the industry, based on size and legal organization. The effects of different proposed profit factor formulae as applied to these data are shown.

The conclusions reached and recommendations made in the dissertation are:

1. Prepaid expenses should be substituted for incurred expenses, which are presently used in the statutory underwriting profit or loss procedure.

2. There should be no change in the calculation of the unearned premium reserve, but a prepaid expense asset which would reflect the amount of equity in this reserve should be established for purposes of rate-making, although it probably should not be recognized by regulatory officials for purposes of testing company solvency.

3. Gains and losses from asset sales and valuation changes should be reflected in a special reserve which would not be considered as part of a company's policyholders' surplus (except upon liquidation, merger or sale of the company), and such fluctuations should not be considered as income profit or loss when the results of the company's operations for the year are reported.

4. Investment income attributable to policyholders' funds should be reflected in the rate structure by discounting gross premiums by a reasonable rate of interest, such as 2 per cent.

5. Investment income derived from stockholders' funds should not be considered in determining the underwriting profit factor for casualty companies.

6. Stockholders' equity is the proper base against which to measure underwriting profits. The profit factor would be converted into terms of premium writings to make it a part of the rate structure.

7. Contingency allowances should be a part of pure premiums and not part of the profit factor.

Microfilm \$3.05; Xerox \$10.40. 233 pages.

SELECTED METHODS AND PROCEDURES FOR EVALUATING SALES TRAINING

(L. C. Card No. Mic 59-2320)

David Joseph Schwartz, Jr., Ph.D.
The Ohio State University, 1953

For purposes of the investigation, which is a case study of the sales training program of a large insurance company in Columbus, Ohio, five methods have been utilized to determine an evaluation of a given sales training program. These methods involved:

1. The establishment of two control groups of agents, one trained and the second untrained, for the purpose of measuring the effect of training or production

2. A comparison of the deviation of agent production from the company quota before and after training to determine whether training influenced the sales of specific lines of insurance

3. The administration of a test based on the subject matter of training to two control groups of agents to ascertain: a) the extent to which trained agents retained the information which had been presented, b) the correlation between test results and sales success as measured by sales volume, and c) the kind of additional training needed by agents

4. The use of a questionnaire based on an agent's job analysis and sent to district managers and to trained, untrained, and terminated agents to determine whether training is provided in the areas where it is needed

5. The analysis of comments which were made by district managers and trained, untrained, and terminated agents pertaining to the training program.

The Control Group Method of Evaluation

Two groups of agents, one trained and the other untrained, were matched on the bases of pretraining production and pretraining length of service with the company in order to determine the effect of training on agent sales volume. In this manner it was possible to eliminate variables other than training, such as seasonal factors, changes in demand, and increases in agent experience which may affect sales volume. Differences in production for the two groups were then noted for two three-month periods following training.

During the first three-month postschool period, average production for the trained group increased by 24.37 more production points¹ than did the average production for the untrained group (see Table 1). The influence of training was limited to the short run, however; in the second three-month period the average difference in production between the two groups had been reduced to 7.60 production points. Furthermore, between the first and second three-month periods, average sales production for trained agents increased only 0.92 point, while average sales volume for untrained agents increased 17.46 points. This tends to indicate that the gain in production noted during the first period may have been due to the inspiration of the training rather than to increased agent knowledge of insurance and selling skills.

TABLE 1

Average Monthly Production for All Paired Trained and Untrained Groups of Agents for Selected Time Periods*
(Data Expressed in Sales Production Points)

TRAINED AGENT GROUPS				UNTRAINED AGENT GROUPS			
GROUP NO.	Average Total Production			GROUP NO.	Average Total Production		
	3-Months Prior to School	1st 3-Months Post-school	2nd 3-Months Post-school		3-Months Prior to School	1st 3-Months Post-school	2nd 3-Months Post-school
1	78.63	106.93	136.07	1	78.20	95.07	121.87
2	88.21	155.64	125.50	2	88.86	99.86	115.36
3	83.81	107.04	105.69	3	83.42	92.77	98.46
4	74.86	96.04	98.00	4	75.05	81.18	92.45
5	110.09	117.61	120.61	5	112.61	83.65	116.18
Average	86.86	112.71	113.63		87.09	88.57	106.03

*Source: Production records of selected insurance agents.

Production-versus-Quota Method of Evaluation

To determine the influence of training on the sale of specific lines of insurance, pretraining and posttraining average production in each line for both trained and untrained agents was compared with the company quota. The evidence indicates that training did not affect the relative proportion of the insurance coverages sold (see Table 2). The indications are that agents, after training, continued to emphasize the same lines of insurance which they had found easiest to sell prior to attending the sales school.

Use of a Test for Evaluation

A test based on the subject matter presented at a one-week sales training school was administered to 16 agents who had received the instruction and to 16 other agents who had obtained the same information from such sources as sales manuals during the same time periods.

TABLE 2

Total Average Absolute Deviation from Company Quota for All Paired Trained and Untrained Groups of Agents for Selected Time Periods*
(Data Expressed in Absolute Per Cent of Deviation)

TRAINED AGENT GROUPS				UNTRAINED AGENT GROUPS			
GROUP NO.	Average Total Production			GROUP NO.	Average Total Production		
	3-Months Prior to school	1st 3-Months Post-school	2nd 3-Months Post-school		3-Months Prior to School	1st 3-Months Post-school	2nd 3-Months Post-school
1	30.4	35.4	22.2	1	22.2	26.8	12.2
2	26.8	13.4	40.4	2	54.8	28.6	21.8
3	22.0	16.2	16.0	3	25.4	21.8	13.2
4	18.0	20.4	9.0	4	26.6	24.8	22.0
5	31.2	39.0	31.4	5	10.2	17.8	20.4
Average	25.7	24.9	25.8		27.8	23.9	17.9

*Source: Production records of selected insurance agents.

The results show that the average score for the school-trained agents was 73.1 per cent, while the average for the agents who had received the informal training was 69.7 per cent. Since the school-trained agents had received considerably more instruction in the subject matter of the test, the difference in the scores, 3.4 points, suggests that relatively little of the information presented at the sales school was retained by the agents.

TABLE 3

Production and Knowledge of Insurance Demonstrated by Selected Insurance Agents Trained at Sales School and Paired Untrained Agents*

TRAINED AGENTS		UNTRAINED AGENTS	
Test Scores (In per cent)	Average Production 2nd Three Months Post-school (Production Points)	Test Scores (In per cent)	Average Production 2nd Three Months Post-school (Production Points)
92	136	89	190
88	139	87	179
87	154	84	158
85	223	81	77
83	166	77	106
81	70	76	157
80	168	72	117
78	123	72	115
76	84	71	107
71	131	68	104
67	87	63	81
63	115	59	102
62	85	59	71
57	100	56	114
52	93	52	68
49	83	49	99
Average	73.1		69.7
Median	76.0		72.0

*Source: Results of tests and production records of selected agents.

It was also revealed by the test that no-significant correlation existed between agent performance on the examination and sales success as measured by sales volume. The correlation between test results and production for the school-trained group was 0.612, while the correlation for

the informally trained group was 0.688. Indications are that some of the subject matter presented at the sales school may not be essential to sales success.

An analysis of the questions most frequently answered incorrectly indicates that additional training from sources other than the sales school is needed in selling both life and general liability insurance coverages.

Use of a Questionnaire for Evaluation

A job analysis was conducted to learn what duties and activities are performed regularly by agents, and what difficulties are encountered by them on the job. This information served as the basis for the construction of a questionnaire designed to determine the kind and quality of training being administered. Despite the fact that trained agents had attended a sales school, there was a striking similarity between the questionnaire answers received from the trained and the untrained groups, which suggests that insofar as subject matter is concerned, the sales training school added relatively little to the agents' fund of knowledge.

Generally, terminated agents claimed to have received less training than either of the other two agent classifications. This low regard for training is believed in part caused by a dissatisfied attitude which several terminated agents had toward the company.

The percentage of district managers who stated that they had given training was larger than the percentage of agents who said they had received such instruction. This discrepancy may have occurred because district managers perhaps thought they had provided training in a certain aspect of the agent's job when actually it was supplied to only some of the agents.

District managers in general were more critical of the quality of the training they had administered than were the agents who had received it. A possible explanation for this is that district managers are better qualified to recognize proper application of training because they have had more experience and because they have developed a more detached attitude toward training.

Areas where much additional training is needed are prospecting, planning work, and selling life and general liability insurance coverages.

Use of Comments Pertaining to the Training Program

Certain weaknesses in the training program were suggested in the form of comments by the respondents to the questionnaire. It was the feeling of many agents that district managers do not provide sufficient instruction on the job. Furthermore, numerous agents believed that district managers need specialized training assistance, which indicates that some district managers may not be properly qualified to train agents in certain aspects of the selling job.

Frequent criticism was made of the manner in which sales meetings were conducted. A significant number of agents felt that the meetings were disorganized, while others stated that they were too long.

Training administered at sales schools was held in high esteem by those agents who had received this instruction, and many of them expressed a desire to see the school made available to all agents, despite the fact that this training had had only a short run favorable influence on agent production. One major adverse criticism made of this training was that too many topics are presented in too short a period of time.

Answers to the questionnaire, test results, and comments made pertaining to specific training needs indicated that many agents feel inadequately prepared to sell both life and general liability insurance. Also, relatively large numbers of agents asked for additional training in planning work and in prospecting.

Two general observations can be made on the comments supplied by district managers. Many of them felt a need for more training, and they wanted more assistance in training from the home office.

Application of the Data to the Company Studied

Research should be undertaken to determine ways for increasing the long-term effectiveness of the sales training schools. The inspirational content of the school is apparently excellent, but the effect of this training on production several months later is negligible. One suggestion for improving the content of the sales training school is to present fewer topics for discussion, allowing more time for each subject.

District managers should receive more training assistance from the home office. Training course outlines, visual selling devices, and aid from sales training specialists would be helpful. District managers should be trained to conduct sales meetings in a more satisfactory manner and should be encouraged to provide their agents with more instruction in the field.

Additional training should be provided agents in prospecting, in planning work, and in selling life and general liability insurance. In three separate phases of the evaluation the need for much additional training in these areas became apparent.

The training curriculum should be revised on the basis of the job analysis to incorporate instruction in all the essential duties and activities of the agent's job. Training should be provided in ways to meet specific difficulties which are encountered by agents.

Application of the Data to Other Sales Training Programs

The methods presented in this study are generally applicable to the appraisal of other sales training programs. The control group method for measuring the effect of training on the quantity and quality of sales volume can be used by any organization which has a sufficiently large number of salesmen to make possible the matching of two control groups on the bases of pretraining sales volume and pretraining length of service. To apply this method, the company must withhold training from one of the two groups for a certain period of time.

A carefully constructed examination based on the content of training can be used by any sales organization to determine the degree to which salesmen retain the information presented to them at the sales schools and to learn what additional training is needed. By comparing test scores with sales volume, it is possible to learn in a general way whether the training provided salesmen is based on subject matter essential to sales success. A high correlation between test results and sales volume is an indication that the content of training is adequate.

The questionnaire method also can be used effectively in appraising any training program, provided the questionnaire is constructed on the basis of an analysis of the salesmen's job. The job analysis will reveal what the content of training should be. The questionnaire can then be used in asking the salesmen to check the various elements of their job in which they have received training

and to rate the quality of the training received in each element.

Comments of salesmen and sales managers can be a fruitful source of information needed in evaluating a sales training program. When this method is used, it is best to ask salesmen to make any comments they wish pertaining to the training they have received, thus avoiding suggesting any type of answer desired. In this manner it is possible to determine the more obvious limitations of training.

To evaluate a training program thoroughly, application of all of these methods is essential for two reasons. No one method can procure all the necessary data, and the validity which can be attached to the results is strengthened if the same findings are obtained by two or more methods.

Microfilm \$3.20; Xerox \$10.80. 245 pages.

1. A production point is a unit of value awarded by the company to an agent for the sale of a specific amount of insurance.

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A STUDY OF THE FORM, CONTENT AND USE OF NOTES TO FINANCIAL STATEMENTS IN CORPORATE ANNUAL REPORTS

(L. C. Card No. Mic 59-2057)

Tom Guthrie Secoy, Ph.D.
University of Illinois, 1959

There are many deficiencies in current corporate reporting--present-day annual reports largely failing to provide all the information essential to the full disclosure of financial position and results of operations. These deficiencies are attributable to the lack of a coherent body of standards and principles of disclosure governing the content and make-up of the annual report. Hence, if the annual report is to be made an effective instrument of full disclosure, a body of such principles and standards must be developed and consistently applied throughout the entire field of corporate reporting.

The major deficiencies involve the disclosure of essential information in addition to the fundamental information in the financial statements proper. This information is disclosed preponderantly in notes to financial statements--although it also is disclosed in other additional disclosures, including supporting schedules, and disclosures in the text of the annual report and the audit report. It follows that a coherent body of standards, principles, and rules governing the use of notes to financial statements must be developed and consistently applied if the major deficiencies in corporate reporting are to be eliminated.

These standards, principles, and rules must be developed from the best practices of the day. By eliminating the defects in current practice and recognizing and using the more effective practices, a basis can be provided for the formulation of a body of evolving standards, principles, and rules which can be given a formal status and enforced throughout the entire field of corporate reporting. Thus the use of notes to financial statements needs to be subjected to recurrent study in order that the most efficacious practices may be known and promoted and the deficient practices eliminated.

This original study of notes to financial statements is concerned with the form, content, and use of notes in current practice to serve as a necessary preliminary to and basis for further studies which will lead to the formulation of a formal body of standards and principles of disclosures in corporate reporting.

It is based on a selected sample of 125 annual reports of industrial and commercial corporations taken to be representative of the reports currently provided to the stockholders of publicly-owned corporations.

Chapters I, II and III are concerned with the historical background of the annual report and the development of notes as the preponderant means of disclosing the essential additional information; an examination of the make-up of financial statements to provide a basis for defining and classifying the types of notes; and an enumeration of the notes found in the sample.

Chapters IV-VII are devoted to a consideration of the characteristics of the notes--including their location and position; their wording and terminology; their length; and various other characteristics. In addition, it was necessary to consider the use of keying devices and cross referencing involving the notes.

Chapters VIII-X are concerned with an analysis, classification and enumeration of the contents of the notes in terms of their subject matter; the types of notes used for the various subjects; the relative importance of these subjects; and the nature of the information involved, primarily in terms of its systematic and periodic relations to financial position and results of operations.

Certain important relations of the notes to the audit report are considered in Chapter XI. Chapters XII and XIII are devoted, respectively, to an analysis and interpretation of the use of the notes, and certain conclusions, suggestions and recommendations drawn from the study.

An appendix containing various exhibits and data is included. Microfilm \$9.25; Xerox \$32.80. 730 pages.

COMPANY POLICIES AND SUPERVISORS' ATTITUDES TOWARD SUPERVISION

(L. C. Card No. Mic 59-1502)

Erwin Schoenfeld Stanton, Ph.D.
Columbia University, 1959

The purpose of this investigation was to study the relation between company policies and supervisors' attitudes toward supervision in two companies, one of which was characterized as having democratic management with the other having an authoritarian management.

It was hypothesized that, in the company whose personnel policies were judged to be democratic in nature, the attitude of supervisors toward their employees would be more considerate than in the company whose personnel policies were judged to be authoritarian. It was further hypothesized that, in the company whose personnel policies were judged to be democratic in nature, the attitude of supervisors would favor imposing less operating structure in their dealings with employees than in the company whose personnel policies were judged to be authoritarian.

Two companies were selected on the assumption that one could be characterized as having democratic policies while the other had authoritarian policies. Policies of both

companies were analyzed and, although there were basic similarities - notably in management's concern for consideration for the employee - there were also some fundamental differences. These differences could be categorized along a democratic-authoritarian continuum and appeared to suggest that the two companies did differ. Raters were asked to evaluate the data which appeared to contrast the two organizations and they agreed that, based on an analysis of company policies, there were significant differences between them.

86 supervisors of clerical and administrative personnel - 28 from the democratic and 58 from the authoritarian company - were administered the Fleishman Leadership Opinion Questionnaire, which yields two factorially-independent dimensions: Consideration and Initiating Structure; and the Nelson Supervisory Practices Inventory, Form D. The results indicated that there was no significant difference between supervisory attitudes in the two companies with regard to the amount of consideration that should be shown for employees. Attitudes of supervisors in the authoritarian company were inclined to be as considerate of their employees as were those of supervisors in the democratic company.

There was, however, a significant difference between supervisors in the two companies with reference to their attitude on the extent of operating structure that they felt should be offered to their employees. Supervisors in the authoritarian company felt that primarily they themselves should structure the behavior of their employees and should allow them relatively little opportunity for participation. Democratic supervisors, however, preferred imposing less operating structure in their dealings with employees and believed in permitting them greater participation.

Previous research has indicated that democratic management, authoritarian management or a compromise approach may be most effective in meeting both organizational goals and individual needs, depending upon specific situational factors in each particular case. This investigation suggests that a company can offer an authoritarian or semi-authoritarian approach to leadership and still show consideration for the employee. The study further suggests that consideration for the desires and feelings of the individual, a basic tenet of our national philosophy, is not necessarily lost under an authoritarian type of industrial management and that it is quite possible that some of the negative connotations of authoritarianism are not justified when applied to industry.

Microfilm \$2.00; Xerox \$5.60. 113 pages.

AN ANALYSIS OF THE JOB OF THE DEPARTMENT STORE BUYER FOR PURPOSES OF TRAINING

(L. C. Card No. Mic 59-2323)

Robert Milton Strahl, Ph.D.
The Ohio State University, 1953

The work assigned to buyers has long been regarded as the most vital job responsibility in American department stores. All goods distributed by these important retail institutions are purchased by their buyers and are sold under the direct supervision of them, who generally function as merchandise department managers. Because

of their status in merchandising divisions, which are hubs of department store operations, they exert a more direct influence on buying and selling activities than does any other store executive. Moreover, there is a tendency for the influence of each store's departmental merchandisers to pervade it, because approximately two-thirds of its executives are employed in such capacities.

Despite the importance of the buyer's job, efforts to provide those who serve in such positions with suitable training have been generally disappointing. In some stores no organized attempt is made to prepare buyers for important areas of their work assignment. In others, the stress given various units of instruction is disproportionate to the relative importance of the tasks buyers must perform. To a considerable extent such circumstances are the result of widespread confusion in the minds of retail executives concerning the appropriate content of training programs for buyers. There are indications that this condition, in turn, is a result of lack of knowledge of the buyer's job.

The present study, therefore, was undertaken with two principal objectives: first, to make a more complete and thorough analysis of the department store buyer's job than has been made heretofore; and, second, to determine, on the basis of this job analysis, a curriculum for training buyers and prospective buyers.

The inquiry is in the form of a case study of buyers employed in a department store which is situated in a mid-western city with a population of about 100,000. Originally organized in 1902 as an independently owned dry goods store, the enterprise has been expanded until approximately 950 regular workers are now employed. Most consumers who live in urban centers would probably recognize it as a counterpart of each of the large independent department stores that vigorously compete for patronage in their own communities.

Conclusions reached are based upon the findings for the store studied. It is intended, however, that executives of similar retail establishments will draw useful implications from the investigation and, with some adaptation, apply the results to their own needs.

Data used in the dissertation were obtained by studying records of a particular store, interviewing its executive personnel, and observing its buyers. Personnel records of each buyer, departmental merchandise plans, and records of all buying trips made during the period from February 1, 1947 to August 1, 1949 were examined. All outgoing correspondence written by buyers in the last eighteen months of this period was read and analyzed. Buyers, divisional merchandise managers, four staff executives, and the firm's two vice-presidents were each interviewed at least once. Selected buyers were successively observed for a total of thirty days, and detailed records were made of types of activities they performed and of time spent by them while engaged in each kind of work. In addition, books and periodicals were searched for information pertinent to the investigation.

Analysis of the activities performed by all members of the buying staff reveals the nature of the typical buyer's responsibility for selling, buying, pricing, and stockkeeping. Departmental sales responsibility consists of personal selling, customer servicing, special promotion, personnel supervising, and sales budgeting duties. In discharging his personal selling duty, he is required to sell to customers, time his selling assistance to his sales force, engage

in departmental housekeeping, and to report sales data. Liability for special promotion involves planning such activities, working with the sales promotion department, and executing his individual duties in connection with special sales events in his department. Personnel supervising duty comprises incumbencies to train workers, develop their morale, control their work activities, and work with the personnel department.

In fulfilling his responsibility for departmental purchases, the buyer is compelled to collect information about demand for the kinds of merchandise he handled, current conditions of his inventory, and supply conditions in markets where he may buy; to plan purchases; and to execute these plans. In some cases purchases may be effected merely by completing the store's purchase-order procedure and following up the vendor's shipment; in others it is also necessary to contact numerous resources, select specific pieces of merchandise, negotiate terms, and strive to develop or maintain good relations with vendors.

Buying and selling are facilitated through the buyer's performance of pricing and stockkeeping functions. Responsibility for stock involves directing the flow of his goods through the store, displaying them, and maintaining and protecting them.

Comparison of all activities identified in this study with those which are reported as results of an investigation conducted by Hogadone in department stores of Rochester, New York, reveals a high degree of similarity in the nature of the work done by both groups of buyers. The five differences between the nature of the activity of the two groups are the result of variations in the degree of authority delegated to buyers or to staff executives with whom buyers work. From the large measure of similarity found in this comparison, it is concluded that the results of a logical job analysis can be applied to planning training for buyers in firms of a similar character.

All types of activities performed by the buyers studied are evaluated from the standpoint of their importance to job success and, subsequently, of their inherent difficulty of performance. It is concluded from this analysis that thirteen kinds of tasks are both especially important and particularly difficult. Six of these are merchandising tasks and involve (1) determination of kinds of merchandise to order, (2) decisions as to quantities of each kind of goods to order, (3) selection of items to be given special promotion, (4) planning of promotional copy, (5) repricing of slow-selling merchandise, and (6) comprehension of departmental figures. The remaining seven are service tasks, which include (1) planning the buyer's own work, (2) handling customer returns and complaints, (3) supervising sales in heavy customer traffic, (4) instructing workers, (5) arousing enthusiasm in salespeople, (6) determining standards of performance for workers, and (7) correcting subordinates. Abilities required of buyers in performing these activities are determined and the course content necessary to enable them to develop these essential faculties is developed from the job analysis.

Two organizational conditions are worthy of note which have an adverse affect on the development of competence in buyers. First, many buyers are performing a number of clerical tasks that might well be delegated to employees receiving lower wages than these department heads. Managerial approval of this situation is inconsistent with its eagerness to have buyers increase their volume of business and to develop a higher caliber of judgment in merchandising and supervisory matters.

Second, management lacks reliable information concerning the individual abilities and knowledge of heads of selling departments. Methods used by a few buyers when customer traffic is heavy are obviously poor. Deficiencies exist among a small number of buyers in their planning of their own work. Until buyers are individually appraised in terms of important tasks which they are required to perform, it is manifestly impossible for sound training schedules to be prepared.

Not all problems of buyers can be dealt with economically by means of organized training. In cases in which the results an employer seeks are not primarily contingent on the development of particular abilities in a buyer, the usefulness of training courses is highly questionable. There are, therefore, limitations in the scope of course content.

It is concluded that no specific unit of instruction can be profitably employed to aid buyers in arousing the enthusiasm of their workers for goods they have to sell. While a full explanation of the buyer's responsibility for handling customers' returns and complaints is necessary, it is not advisable for buyers to be provided with further training in connection with this duty. The use of organized training for the immediate purpose of preparing buyers to interpret demand and supply data in terms of basic purchase and promotional decisions is not prudent.

A sound program of organized training for buyers is used to aid them in developing proficiency in three respects: first, as members of an organization who are informed of their authority and responsibility in it and of the retailing philosophy under which they work; second, as merchandisers; and, third, as supervisors. In such a program instruction concerning store organization deals with the various responsibilities assigned buyers and with the activities they perform in fulfilling these obligations. Tasks of particular importance or difficulty are analyzed, and routine procedures that buyers must follow in performing daily, monthly, and seasonal duties are depicted.

In addition, the manner in which management expects buyers to prosecute their work assignments is dealt with in terms of merchandising policies and organizational structure of the store. All lines of authority and responsibility which are utilized in coordinating and controlling different work assignments are examined, with particular attention being given to the nature of the authority delegated to buyers and to the character of their organizational relationships with staff executives and their subordinates.

Moreover, trainees are afforded an opportunity to learn of services rendered buyers by service departments and to learn the information and assistance they will need from managers of selling departments. Limitations on the assistance that can normally be given buyers by credit, sales promotion, personnel, delivery, receiving and marking, repair, and other staff units are explained.

In a good program of training for buyers, instruction in merchandising involves explanations of the meaning and purposes of stock control, of the nature of alternative methods of controlling inventories in terms of dollars or physical units, and of the advantages and disadvantages of methods used to collect data required in the operation of these systems. Information concerning uses of various control methods and reasons underlying particular applications of these techniques is a requisite part of this segment of the program.

Mathematical aspects of merchandising are also a fundamental portion of this training. The significance of discounts and datings commonly used by wholesale vendors

and of various forms of markup is studied. Careful consideration is given to turnover as a basic merchandising concept, to implications of fast and slow rates of turnover, and to the stock-sales ratio and its use in inventory planning and control. Trainees are acquainted with the open-to-buy concept and its relation to the planning of purchases. Advanced study of the nature of operating statements and merchandise budgets as managerial tools is provided.

Further subject matter pertaining to advertising and selling principles is utilized to lead those who participate in this phase of training to sense the significance of promotional copy as a factor in selling. Opportunities are given those in training to study the requirements of good copy and its relation to buying motives and selling points.

Course content which is appropriate for aiding buyer trainees without supervisory experience in undertaking responsibility for the work of others consists of data about attitudes and judgments of experienced retail supervisors concerning problems in the area of personnel relations. These pertain to the diagnosing of reactions, the maintaining of emotional equilibrium, and the securing of action and cooperation of individuals and groups. Reports of concrete cases by trained experienced buyers in which leadership responsibility is implicit are used for analysis. Ideas contributed to these discussions by participants, as well as specific information about group behavior, are used as study materials.

In addition, store policies and work experience information pertaining to the correction of workers are provided. Purposes and procedures for redirecting subordinates and the necessity for buyers to develop this skill are explained. Circumstances involving problems in directing and controlling operative employees are analyzed.

Moreover, instruction in the use of methods of sales supervision applicable when customer traffic is heavy is presented. Measures useful to encouraging efficiency among employees working under this condition are considered. In this connection, techniques for customer service and departmental control are illustrated.

Sales instruction training is an essential segment of a program of training for buyers because of the need for them to inform and instruct their salespeople and to convince them of the salability of merchandise stocked. Because of the nature of these requirements, trainees are required to concentrate upon the planning of departmental sales meetings, formulation of selling appeals, demonstration of the operation or application of products, and the treatment of objections.

It has long been true of department store merchandising that while much is demanded of managers of selling departments, little is effectively done to develop their abilities to measure up to these demands. It is believed that this exposition is a significant step in remedying this condition. First, the course content developed is a sound means of resolving a considerable part of the problem faced by retail executives who wish to develop in buyers those abilities which are essential for their work. Moreover, such a curriculum is a well-founded basis for the study of those who seek to determine the most efficient instructional techniques for instilling various kinds of knowledge in the minds of trainees employed in retail establishments. Inasmuch as this course of study can be utilized to speed the development of proficiency in buyers and prospective buyers, it is a contribution to increased efficiency of department store operation.

Secondly, conclusions are reached that are believed to be general truths having wide application in the training of departmental merchandisers. These pertain to the effect of managerial approval of the performance of numerous routing tasks on the development of buyers and to the general limitations affecting the use of organized training.

Also, methodology is developed by study of research procedures used previously in various fields and by experimentation with techniques for gathering data. The determination of training needs by analyzing activity data from the standpoint of job requirements and of job difficulties is demonstrated. While the application of the time-study technique to the work of buyers is the only original feature of the methods used to collect data, it is believed that there is considerable merit in the combination of methods used for this purpose.

Lastly, the investigation has been used to systematize an important segment of retail knowledge. Much vagueness concerning the retail buyer's work has thus been dispelled. This synthesis of data is offered store executives as an aid in developing in trainees valid conceptions of the buyer's duties and the organizational environment in which they must be performed.

Microfilm \$2.45; Xerox \$8.60. 188 pages.

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ECONOMICS, FINANCE

FACTORS AFFECTING EQUITY FINANCING OF LARGE AMERICAN INDUSTRIAL CORPORATIONS, 1946-56

(L. C. Card No. Mic 59-2007)

Oswald Doniece Bowlin, Ph.D.
University of Illinois, 1959

Equity issues in the first few years immediately following World War II made up only a very small proportion of the total long-term external financing which was done by corporations in the United States. This situation caused a great deal of concern about the factors which affect corporate financing. Since the extent of external equity financing varied considerably from the end of World War II through 1956, much can be learned about the effect of many of the important factors by a study of the financing by corporations during that period.

The ratio of external equity financing to total long-term external financing of large industrial corporations varied to an even greater extent than did the ratio for all corporations. The purpose of this thesis is (1) to determine the most important factors which caused the fluctuations in the dollar amount of capital obtained from equity issues and in the amount of capital obtained from equity issues relative to the amount obtained from other methods of long-term external financing by large industrial corporations in the period 1946-56 and (2) to determine the way in which each of these factors affected equity issues in the period.

The data for the study came primarily from a sample of 100 of the 500 largest industrials in the United States

in 1955. Since almost all of the preferred stock issues by the corporations were found to be creditorship in nature, equity issues as defined in the thesis include only common stock issues. Preferred stock is considered long-term debt.

The aggregate data from the corporations indicate that the financial plans in general were supported sufficiently by equity capital throughout the entire period. Since debt financing accounted for a very large proportion of total long-term external financing, equity ratios were sustained by the high level of retained earnings in most of the years. Sound equity ratios, low financial charges, and good earnings during most of the period meant that debt financing could be used predominately to obtain any outside capital which was needed without incurring an excessive amount of financial risk.

Four factors seem to explain most of the variation in equity issues from 1946-56: (1) price-earnings ratios (estimated by lagging Moody's averages for 125 industrials by three months), (2) earnings of the corporations measured by the rate of return on the total tangible assets (computed by dividing the aggregate earnings after all expenses but before interest and income taxes by the total assets of all the corporations), (3) the income and profits tax changes of 1950, and (4) changes in the total amount of external financing caused by outside factors such as the beginning and the end of the Korean Conflict. Equity issues were positively correlated with each of the four factors except the tax changes of 1950.

The amount of external equity financing was apparently more sensitive to changes in price-earnings ratios than to changes in any other single factor, but the ratio of external equity financing to total long-term external financing indicated a better correlation with the rate of return as defined above. An increase in earnings tended to reduce the amount of outside capital needed and to improve the market conditions for stock issues. This apparently caused a reduction in debt financing but an increase in equity issues.

In conclusion, the evidence indicates that there was no real scarcity of equity capital for large industrial corporations in the period 1946-56. The amount of capital obtained from external equity financing, however, varied considerably over the period and was very small in many of the years. Good earnings and high price-earnings ratios seem to have caused significant increases in the extent of external equity financing.

Microfilm \$2.00; Xerox \$6.40. 135 pages.

COMMERCIAL BANK TREATMENT OF BAD DEBT LOSSES, ITS RELATIONSHIP TO THE ECONOMIC AND ACCOUNTING CONCEPTS OF INCOME MEASUREMENT, AND THE EFFECTS OF THE FEDERAL INCOME TAX REQUIREMENTS

(L. C. Card No. Mic 58-5304)

John Thomas Burke, Ph.D.
Michigan State University, 1958

Supervisor: R. W. Lindholm

The requirements of the Federal income tax regulations have historically been the determinant factor in the

procedure followed by commercial banks in handling bad debt losses. Before 1948 no specific procedure had been set forth by the Bureau of Internal Revenue and banks usually followed the procedure of charging off accounts on a current basis when they were deemed uncollectible. December 8, 1947 the Bureau issued a ruling which established a formula that could be used for setting up valuation reserves to provide for the treatment of bad debt losses. A supplemental ruling was issued during 1954 which provided an alternative bad debt formula. These rulings have not been completely accepted by bankers and have been criticized as inadequate and not in conformity with historical bad debt loss experience.

This study was undertaken in order to determine the significance and relationship of the bad debt deduction to commercial bank income and to determine the basis for the bad debt deduction that would result in the most accurate measurement of income.

The amounts and timing of bad debt losses were found to be one of three major influences on bank earnings before income taxes. Therefore, it was considered of utmost importance that the most correct amount be used as the deduction to determine annual net income before income taxes.

The financial structure and operating results of all insured commercial banks in the United States were examined. A study was made of 34 commercial banks and the percentage ratios for the two groups were compared with special emphasis on the relationship of bad debt losses. The study of all insured commercial banks revealed the close relationship between bad debt charge-offs and the net profits figure after income taxes. Income measurement was considered an accounting problem, which when employed for income measurement by commercial banks, was determined to be in little conflict with the economist's definition.

The historical methods employed for bad debt charge-offs, the present methods allowed for tax purposes, and the methods proposed by banking groups were all found to be in conflict with proper income determination. The problem of faulty income determination caused by emphasis on valuation was discovered to be a major cause of conflict between the past, present, and proposed bad debt charge-off methods.

A recommendation was made that the reserve method be used and that the bad debt experience factor formula for each bank should be computed upon the individual banks' experience. The formula would emphasize income determination rather than asset valuation. It was recommended that the bad debt experience factor formula be based on a shorter period of time than the 20 years now used in order to more closely associate the experience factor with current operations rather than with past experience.

Microfilm \$2.30; Xerox \$8.00. 174 pages.

FEDERAL MARGIN REQUIREMENTS: A SELECTIVE INSTRUMENT OF MONETARY POLICY

(L. C. Card No. Mic 58-3332)

Robert Early Harris, Ph.D.
University of Pennsylvania, 1958

Supervisor: Dr. C. R. Whittlesey

Federal margin requirements constitute a significant refinement in the evolution of Federal Reserve policy. Yet, after almost 25 years of experience and increasing respectability to the instrument, a thorough treatise devoted specifically to it had not appeared. This study undertakes a broad treatment of the subject.

Conceptual aspects and controversies are first examined. The mechanics and measurement of stock market credit are explained as are resources for analysis of margin trading activity. The economic and historical background of margin regulation and prior efforts to control stock market credit excesses are reviewed. The legislative history of margin regulatory authority is traced, and the implementation through the technical formulation and adaptation of Regulations T and U is detailed. Policy is approached chronologically, with each Federal Reserve action discussed and appraised in its particular economic setting. A serious effort is made to analyze and determine some of the more significant relationships between margin requirements and, successively, margin trading activity and stock market credit volume, common stock prices, share trading volume, capital markets, and organized processes in the secondary marketing of securities. Finally, certain deficiencies and limitations on margin regulation deserving of further or continuing attention are noted.

Margin requirements, in regulating the terms of transactions in securities, continue a subject of some controversy. A majority of economists, perhaps, view the selective concept--particularly margin requirements--as a useful addition to resources of monetary authorities. Major criticism centers around contentions that the techniques are both ineffective and authoritarian. Supporters generally view selective regulations as supplementary to other instruments, not substitutive, and of only limited usefulness in the management of general economic tendencies.

Stock market credit, arising from net flows of payments between cash and margin traders, is measured by several statistical series. But there are serious shortcomings in the measures, and the resources for examining margin trading activity are even more deficient.

The highly developed margin trading mechanism is uniquely American. Earlier difficulties arose basically out of a direct linkage of bank reserves and stock speculation. Legislative consideration of margin regulation was strong enough to bring speculative credit extended both by brokers and by banks under effective control.

The implementing regulations, their interpretations, or amendment are not open to severe criticism on technical grounds. The record of policy in establishing the level of margin requirements, however, is only moderately satisfactory. The more serious difficulties have been conceptual in nature, resulting on repeated occasions in general rather than selective applications, diminishing the unique usefulness of the instrument in quieting stock market disorders. Lesser deficiencies such as uncertainty, confusion, insensitivity to changing conditions, and an

extreme penchant for silence were also manifest and weakened policy effectiveness.

Changes in margin requirements appear to have exerted a direct and striking influence on margin trading activity and on the volume and behavior of stock market credit, although all components of credit aggregates were not equally responsive. A relationship with stock price composites, while less marked particularly in the short range, was also definitely indicated. Highly speculative shares appeared almost dramatically responsive, a finding with rather significant policy implications. Trading volume also appears to have been definitely influenced, though again less so than credit, particularly in the short range. Comparative influences exerted on special classes of traders are uncertain. Contentions that margin requirements have impaired the liquidity, stability, or continuity of security marketing processes could not be established.

Continuing attention to developing problems of unlisted and exempt securities, nonpurpose loans, diversion of speculative activity domestically and through foreign agents, institutional investment trends, and formulae regulation is suggested. Microfilm \$6.95; Xerox \$24.00. 547 pages.

BANK LENDING TO SALES FINANCE COMPANIES, DECEMBER 1951 - JUNE 1956

(L. C. Card No. Mic 59-2236)

Robert Carl Holland, Ph.D.
University of Pennsylvania, 1959

Supervisor: Professor C. R. Whittlesey

Serious appraisal of the influence of "tight" or "easy" money requires insight into the mechanisms by which credit is (or is not) distributed. This is particularly true with respect to the field of bank credit, which is a compound of free and administered markets, of price and nonprice allocators, of subjective and objective weighting of considerations. This thesis attempts a detailed exposition of the workings of the mechanisms of credit distribution in that segment of bank credit in which they can be most clearly perceived, namely, in bank lending to sales finance companies.

Most of the information presented was obtained in connection with two sets of studies of the financial system undertaken by the Federal Reserve System—one, in 1956 and 1957, concerning consumer instalment credit, and a second, in 1957 and 1958, concerning the financing of small business. In each case, a wide-ranging series of personal interviews was conducted, and these produced an abundance of qualitative evidence regarding the prevailing practices of credit allocation as seen through the eyes of bankers, finance company officials, auto dealers and consumers. Interview information was complemented by quantitative data from formal surveys of relevant balance sheet items and operating experience of banks and of finance companies. While each particular survey or set of interviews had a unique focus, a considerable part of the information so obtained can be employed to illuminate, directly or indirectly, the relationships between banks and sales finance companies as they developed between 1951 and 1956.

The thesis assembles and correlates such information

in four stages. First, historical evidence is reviewed to ascertain the longer-run patterns in bank accommodation of sales finance companies. Second, bank attitudes toward lending to sales finance companies, and the procedures for such lending are appraised. Third, changes in the volume, terms and conditions of bank accommodation of sales finance companies from 1952 through mid-1956 are reviewed. Finally, to the extent permitted by the data, analysis is made of the effects and implications of the changes in bank accommodation which occurred.

The terms and conditions of a bank loan are influenced by a variety of considerations. In lending to sales finance companies, these considerations are complicated by the fact that finance firms are very sophisticated borrowers with sharply fluctuating needs for bank funds. To deal with such needs, banks have utilized both price and nonprice allocators. The price allocators (chiefly interest rate and compensating balance) have fluctuated substantially with the ups and downs of business, but bankers preserve homogeneity in treatment of any single borrower by insisting (usually) that he pay the same price for bank money regardless of where obtained. Nonprice rationing measures have been introduced around peaks of credit demand and occasionally have progressed in some banks to a flat ban on any further loans to the finance industry. Such allocators are applied with some discrimination among types of sales finance companies; more advantageous treatment is given to the largest and most creditworthy firms, and to those concerns which are finance subsidiaries of other valued customers of the banks. There is little substitutability among these various allocators, however, and as conventionally applied they make for industry-wide rigidities which reduce the flexibility of bank credit.

The evidence makes it clear that sales finance companies have been affected by changes in the availability of bank credit. Some of these effects appear to have been reflected in finance company shifts to other sources of funds, and others in some moderation in rate of growth of receivables. More precise judgments as to the significance of these responses must await complementary analyses of such related credit areas. It is believed that the methods and findings of the current inquiry represent promising points of departure for such further studies.

Microfilm \$4.10; Xerox \$13.80. 318 pages.

A STUDY OF DEBT ADJUSTMENT IN MICHIGAN

(L. C. Card No. Mic 59-1846)

Bud R. Hutchinson, Ph.D.

University of Southern California, 1959

Chairman: Professor C. W. Phelps

Debt adjustment is a relatively new method of rehabilitating overindebted consumers. For a fee, adjusters negotiate with the debtor's creditors to obtain reductions in the size of monthly payments owed by the debtor. Using the debtor's money, the adjuster makes all payments to creditors. In this study the writer attempts to explain the nature of this service and evaluate its place in the system of consumer credit.

Various methods for rehabilitating debtors exist. However, in the view of many debtors, existing techniques are

inadequate. Seemingly capable of filling a need, many debt adjustment firms have come into existence in recent years. As of 1956 there were approximately 300 debt adjustment offices in the nation with 28 of these located in Michigan. At any given moment these 28 Michigan offices managed the financial affairs of almost 4,000 families. Approximately \$3,750,000 was remitted to creditors by Michigan adjusters during that year.

Three prime sources were relied upon to gain information for this study: creditors who had dealt with debt adjusters, debtors who were or had been customers of debt adjusters, and the adjusters themselves. Creditors were surveyed by means of a questionnaire. Customers were personally interviewed, while debt adjusters were studied by means of a questionnaire and personal visits to their places of business where the writer was able to examine their records and observe their procedures. Other sources of information included trade and professional journals, newspapers and periodicals, Better Business Bureau publications, and pamphlet literature. The records of a subcommittee of the Michigan State Senate, which conducted hearings in Detroit on debt adjustment activities in that city, were also examined. Proponents and critics of debt adjustment supplied the writer with materials stating the case for and against the service.

The study begins by reviewing the problems faced by overburdened debtors. Next, the service is described, and some indication of its scope and importance is given. Reasons underlying the growth of the business are then presented. There follows a description of the types of persons attracted to this service. Then, adjustment firms are pictured in terms of their personnel needs, the physical plants occupied by them, and their organizational and financial structure. Operating methods of adjusters, including charges made for their services, methods used to attract customers, and their use of legal instruments, are then described. Attitudes of customers and creditors toward the service are explained. The current legal status of the business and the various abuses which have characterized the operations of many firms are then set forth. Finally, recommendations are made as to appropriate public policy.

In the absence of regulation, many customers of debt adjusters have had their debt problems compounded. Consequently, ten states have outlawed this business since 1955. However, the writer favors regulation over prohibition, as he feels that a competent debt adjuster can perform a worth-while function.

A regulatory bill should provide for licensing, bonding, continuing surveillance of licensees' operations, control of advertising claims, the establishment of procedures for accounting to customers, and a requirement that contracts demand specific performance by both parties. Customers should have the right of prepayment, charges made should be clearly stated, and customers should receive copies of all documents signed by them. The writer favors rate regulation and suggests a range of from 8 to 12 per cent of the total amount of debt serviced as a reasonable charge. Within this rate range, charges should be proportional to the time required to liquidate all debts. Setup charges should not be permitted. Any regulatory bill should require compulsory amortization of charges over the period of debt servicing.

Microfilm \$7.75; Xerox \$26.60. 611 pages.

THE TAXATION OF SELECTED FINANCIAL INSTITUTIONS IN OHIO

(L. C. Card No. Mic 59-2309)

Leland Charles Lehman, Ph.D.
The Ohio State University, 1953

Financial institutions have long been singled out for special tax treatment. Such special treatment stems from the peculiar characteristics of financial institutions, from a recognition that they constitute a potentially lucrative source of revenue and in value various levels of government in their chartering and regulation. Consequently, the problems incident to the taxation of financial institutions continue to manifest themselves.

To make the dissertation manageable it is limited chiefly to Ohio and the taxes it imposes on three deposit-receiving financial institutions, namely, commercial banks, savings and loan associations, and credit unions.¹ The intent of the study is to examine and compare Ohio's taxation of these institutions with a view to a critical analysis of the various issues involved. To do so, the historical, descriptive, deductive, statistical, and questionnaire technique are all employed as methods of analysis. Most of the primary data are taken from government documents issued by the regulatory agencies involved.

Ohio, like all states, is restricted in the taxation of financial institutions because of the requirements of federal law. Owing to the limitations of federal law, variations in the tax treatment of financial institutions continue to exist despite the apparent desire for uniformity of treatment. More specifically, three taxes imposed by Ohio which especially affect financial institutions are given prime consideration. These taxes are the corporation franchise tax, the intangibles tax imposed on shares or capital employed, and the intangibles tax on deposits. Each of these taxes currently present various problems as applied to financial institutions.

The Ohio corporation franchise tax applies to all corporations doing business in Ohio. A tax of .1 of 1 per cent on the "value of the issued and outstanding shares of stock" allocated to Ohio is exacted for the privilege of doing business in this state. Strangely, of the financial institutions considered, only state chartered commercial banks are subject to this tax. National banks and federal credit unions are exempt by virtue of the United States Code, and savings and loan associations escape by provisions of the Ohio Code.² Until recently this constituted one of the more obvious discriminations against state chartered banks. Now, however, even these institutions pay only the minimum fee of \$25.00 as a result of an Ohio Supreme Court decision.³ In this case the question before the Court was that of the proper method of determining the base for the franchise tax. In arriving at the value of the capital employed the corporations involved claimed that the value of federal securities owned should be excluded. In the absence of such exclusion they argued that an illegal tax was imposed on federal securities. Although the Ohio Tax Commissioner readily agreed that a state tax on federal securities was illegal, he contended that the franchise tax was an excise levied upon a privilege granted by the state and not a tax upon the property itself. The Court, however, ruled that it did constitute a tax on federal securities contrary to both state and federal law.⁴ Since all banks today own large amounts of United States government securities,

their tax base for purposes of the franchise tax becomes negative, and as a result, they pay only the minimum fee. While this effects greater equity among financial institutions, it creates greater inequity between financial institutions and other business corporations which do not in the course of their normal business find it expedient to own large amounts of government securities.

More important than the franchise tax is the Ohio tax of .2 of 1 per cent levied on the book value of financial institution shares. In case the capital is not divided into shares the tax is upon "the capital employed, or the property representing it."⁵ This tax applied to all financial institutions located in Ohio except federal credit unions which are again exempt owing to their express exemption from such a tax under the United States Code.⁶ The tax may be applied to national banks since the share tax is one of the four methods authorized by Section 5219. Since Ohio applies the low rate of .2 of 1 per cent applicable to intangibles, generally any possible complaints by national banks that they are taxed higher than "other moneyed capital" is avoided. Until recently no problem arose in applying this tax to all savings and loan associations. However, the Wrenn decision referred to above has been broadened in its applications by the Ohio Board of Tax Appeals in such a way that this tax is no longer effective in the case of mutually organized financial institutions. Following the Wrenn decision, financial institutions immediately claimed that the principle of deducting government bonds from capital accounts should also apply to the share tax, since the base for this tax is determined in essentially the same way as is the base for the franchise tax. This contention was upheld by the Ohio Board of Tax Appeals in the cases involving mutually organized financial institutions.⁷ That is, the Board held that the share tax is on the capital of the organization and that as such it strikes federal securities; consequently, they are to be deducted from the capital employed in determining the tax base. The Board, however, denied the contention in the case of commercial banks having permanent capital stock.⁸ Such denial was based on the fact that the share tax is on the shares or stockholder rather than the capital of the institution as such and further that with respect to national banks the share tax is authorized by federal law, making the tax legal even if it should strike federal securities. The effect of the Board's decisions, then, is to exempt Ohio's three mutual savings banks and all mutually organized savings and loan associations from the share tax because their holdings of government securities far exceed their capital employed.⁹

An interesting aspect of the Ohio Tax system is the tax on deposits with provision for collection at the source. Under the Ohio law financial institutions are required to report to the Department of Taxation the magnitude of their deposits and to pay upon these an annual tax of two mills per dollar of actual value.¹⁰ Although legally a tax on the depositor, in its initial impact the tax is upon the financial institution because it makes the report and pays the tax. Although the rate on deposits is the same as on shares, the base is much broader and consequently the tax liability correspondingly greater. In 1952 Ohio collected over \$15 million or about 3.5 per cent of its total revenue from this tax. For commercial banks the deposit tax constitutes approximately three-fourths of all their tax liabilities if the federal corporation income tax is excluded. As such, the initial tax liability is of substantial magnitude and is considered to be moderately important as compared to

labor and interest costs. Therefore, the question of the final incidence of this tax becomes important. If it is finally borne by the institutions themselves, Ohio financial institutions are relatively heavily taxed compared to those in other states. But if the tax is shifted to others, Ohio financial institutions are taxed very moderately at the state level.

To determine with finality the incidence of the deposit tax as well as the other taxes imposed upon financial institutions is difficult. Theoretically, the incidence of the deposit tax is shifted in the long run because it is an added cost of operation which for practical reasons must be paid by marginal as well as supra-marginal firms. However, if the views of bankers and savings and loan association executives are taken seriously, there is some doubt as to whether or not the tax can be shifted from the institution to others. When polled on this question, 59 per cent of the bankers and 65 per cent of the savings and loan association executives thought it impossible for their institution to shift the deposit tax to others.¹¹ These bankers and executives were of the opinion that their institutions were forced to absorb the deposit tax either by lower retained earnings, lower stockholder dividends, or by a combination of both. By contrast, 41 per cent of the bankers and 34 per cent of the savings and loan association executives believed that the deposit tax could be shifted, or at least qualified their answers. These individuals took the view that the tax was completely or partially shifted by a combination of price adjustments. Specific price adjustments most frequently checked by the respondents were "lower interest payments on time deposits" and, for commercial banks, "higher service charges on demand deposits." Other price adjustments checked less frequently included "higher interest on loans to borrowers" and "lower wages and salaries." Thus it must be admitted that there are differences of opinion with regard to the incidence of the deposit tax and that one cannot be certain of its final incidence. Very probably its incidence varies from locality to locality depending on the local circumstances involved.

The findings of the study suggest that Ohio seeks to impose uniform initial tax burdens on its deposit-receiving financial institutions. In practice, however, several exceptions arise from the nature of federal statutes regulating federally chartered institutions. This results in minor inequities which should not be overlooked. Another conclusion is that, in comparison to financial institutions in other states, Ohio financial institutions pay very heavy initial state taxes. This results from the collection of the deposit tax at the source. Whether or not Ohio financial institutions ultimately bear heavy state tax burdens hinges on one's views regarding the incidence of the deposit tax. It may also be noted that the problems of intergovernmental relationships are consequential in this area. This is evident not only from the inequities cited above but also from the variety of implications for financial institution taxation in Ohio which have arisen from the Wrenn Paper decision.

In view of the problems and findings involved various tentative recommendations are made. These include (1) exemption of state commercial banks from the corporation franchise tax, (2) an increase in the rate imposed on financial institution shares from 2 to 3 mills per dollar, (3) a new tax of .7 per cent of gross operating income in lieu of the share tax for all mutually organized financial institutions that cannot be taxed on their "invested capital" until a deduction is made for their holdings of United States

government bond, and (4) a continuation of the 2 mill deposit tax with collection at the source. If these, along with several other minor recommendations which are suggested, are carried out, it is believed that different types of financial institutions in Ohio will be taxed more equitably and that the Ohio tax system will be strengthened.

Microfilm \$5.20; Xerox \$18.40. 406 pages.

1. Withdrawable shares of savings and loan associations and credit unions are defined as deposits by Section 5701.05 of the Ohio Revised Code.

2. National banks may only be taxed by one of the methods provided for in Title 12, Chapter 4, Section 548 of the United States Code (formerly Section 5219, United States Revised Statutes). Since a franchise tax of this type is not one of the four methods provided, it may not be applied to national banks. Title 12, Section 1768 of the United States Code grants an outright exemption to federal credit unions from this type of tax. Title 12, Section 1464 (h) of the United States Code permits states to tax federal savings and loan associations in the same manner as its own state chartered associations.

3. The Wrenn Paper Co., Appellant, v. Glander, Tax Commr., Appellee, 156 Ohio St. 583 and 158 Ohio St. 15.

4. Title 31, Section 742 of the United States Code and Sections 5733.05, 5709.02, and 5709.03 of the Ohio Revised Code.

5. Sections 5725.04 and 5725.07, Ohio Revised Code.

6. Title 12, Section 1768.

7. Society for Savings in the City of Cleveland, Appellant, v. John W. Peck, Tax Commissioner of Ohio, Appellee, Ohio Board of Tax Appeals, March 2, 1953, No. 22464; and First Federal Savings and Loan Association of Warren, Appellant, v. John W. Peck, Tax Commissioner of Ohio, Appellee, Ohio Board of Tax Appeals, March 2, 1953, No. 22533.

8. The First National Bank of Akron, Appellant, v. John W. Peck, Tax Commissioner of Ohio, Appellee, Ohio Board of Tax Appeals, March 2, 1953, No. 22531.

9. These decisions of the Ohio Board of Tax Appeals have been appealed and are to be heard by the Ohio Supreme Court in the following cases: First Federal Savings and Loan Association v. Peck, O.S. Nos. 33524 and 33525; Fifth Third Union Trust Co., v. Peck, O.S. No. 33526; Society for Savings v. Peck, O.S. No. 33523; and First National Bank v. Peck, O.S. Nos. 33518, 33519, 33520, 33521, and 33522.

10. Withdrawable shares of savings and loan associations and state credit unions are defined as deposits by Section 5701.05, Ohio Revised Code. Federal credit unions, however, are not obligated to collect this tax by virtue of Title 12, Section 1768, United States Code.

11. These are the results of the tabulation of 446 replies from bankers and 331 replies from savings and loan association executives to a questionnaire dealing specifically with the incidence of the deposit tax.

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**CONSUMER INSTALMENT LOANS: ANALYSIS BY
PRINCIPAL TYPES OF LENDING INSTITUTIONS
AND BY TYPES OF BORROWERS**

(L. C. Card No. Mic 59-2316)

Winnie David Robbins, Ph.D.
The Ohio State University, 1953

Consumer credit is an integral part of American life. Wisely used, it serves well. Credit used by consumers for their personal needs consists mainly of three types: retail charge account credit, instalment sales credit, and loans of cash. Cash credit comprises single payment loans and loans repayable in instalments. For some years, consumer instalment loans have tended to become increasingly important in our economy.

The services that consumer instalment lending institutions render to the community are very important. Cash instalment credit is basically justified by its capacity to satisfy human wants. It is used to meet emergencies and other needs when current income or accumulated savings fail to provide for them. Many borrowers of consumer instalment loans are in urgent need of immediate funds in order to cope with emergency situations. Such loans must and will be granted. If they are not granted by lawful lenders at fair rates of interest they will be granted by illegal lenders at unreasonable rates. Instalment credit is of economic utility to the consumer because it permits him to stabilize his consumption through the process of pledging future income for present satisfactions.

Many consumer instalment loans are made for the purpose of consolidating overdue obligations. Instead of creating new debt, these loans merely convert debts already incurred into instalment form. Such loans not only permit the borrower to retain his credit rating and self respect, but also provide the merchants of the community with cash funds for those accounts hitherto considered doubtful. Many persons have the erroneous impression that a high proportion of such loans must be charged off as losses. The facts are otherwise. The placing of such accounts on a carefully planned monthly payment schedule usually results in complete repayment of the debt. It is not a high degree of uncollectibility that chiefly characterizes the lending of small sums of money, but rather the high level of expense incident to such activity.

Need for knowledge of the subject

Many people do not appreciate the vital importance of the consumer lending function. They do not realize how large a segment of our population the principal consumer instalment lenders serve. In spite of the economic necessity of consumer loans, even today, fourteen states have no effective consumer loan legislation. In the other 34 states there is always the possibility that the state legislatures may hastily repeal their small loan laws, as has happened in recent years in several states. In most states where this has happened it has only taken a few months for the legislators to realize their mistake, since the legitimate lenders were driven from the state and "loan sharks" came back in force.

Illegal lenders can never be eliminated completely; however, the enactment of the Uniform Small Loan Law contributes immeasurably toward their elimination since loan funds are made available through state supervised lenders. It would seem that the reinstatement of the

Uniform Small Loan Law would rectify the mistaken of the legislators, but it takes several years to again rid the state of the illegal lenders.

The present study was undertaken with the major objective of determining the need for consumer instalment lenders and their contribution to our society. Since this industry is one that is little understood and much misunderstood, a comprehensive study of the nature and purpose of consumer instalment loans and especially of the characteristics of the borrowers might result in a definite contribution to knowledge in this field. To this end, a comparison was made of loan characteristics and of borrower characteristics respecting each of the three principal types of lending institutions, personal finance companies, instalment loan departments of commercial banks, and credit unions.

Method of study

The principal source for data presented in the study was the applications for loans used by lenders to record essential information concerning the prospective borrowers. Information concerning loan characteristics and borrower characteristics from 7,825,660 individual consumer instalment loans was included. The study included eighteen personal finance companies operating 2,262 offices located in thirty-eight states, twenty-two commercial banks located in ten states, and seven credit unions located in two states.

Material was gleaned from a variety of secondary sources. The most important of these consisted of annual reports of the state banking departments which publish information concerning the operation of licensed personal finance companies. Textbooks and previous studies in the consumer credit field contributed to appropriate chapters.

Competitive Status of the Principal Consumer Instalment Lending Institutions

All of the principal types of consumer instalment lending institutions have increased their dollar volume of loans since the late 1920's. Their relative positions, based on dollar volume of loans, however, have changed significantly during their period of growth. The most important change has occurred in the commercial banking field. Commercial banks were comparatively insignificant in this field of operation in 1929; today they are the most important consumer instalment lending institution. Personal finance companies, formerly the principal source of consumer instalment loans, are today the second in importance. Credit unions came from an obscure position to occupy third place.

In the field of personal instalment loans,¹ as distinguished from the more comprehensive consumer instalment loans, commercial banks have greatly increased their volume of loans, but the relative position occupied by commercial banks and personal finance companies has not changed substantially since 1929. Personal finance companies today, as formerly, occupy the first position. These two principal instalment lenders account for approximately two-thirds of the total volume of personal instalment loans.

A comparison of the competitive status of the principal lenders invariably uses consumer instalment loan statistics. Since personal instalment loans actually represent the important area of competition between the three principal lender types, this comparison is not altogether valid. More than 75 per cent of personal finance company loans

and approximately 60 per cent of credit union loans consist of personal instalment loans. On the other hand, less than 45 per cent of the volume of consumer instalment loans of commercial banks consists of personal instalment loans. For purposes of comparison, therefore, personal instalment loan statistics are more significant than consumer loan statistics.

Since the average size loan made by personal finance companies is typically much smaller than commercial bank or credit union loans, personal finance companies extend a great many more individual loans than do the other lenders. In number of establishments which each of the principal types of lenders has in operation credit unions occupy the first place. Second in this respect are personal finance companies, followed by commercial banks.

Each of the principal types of lending institutions is important and all make a definite contribution to society. Each type competes with the other types for a certain segment of the consumer loan market, but the area of competition is not nearly as important as the fact that all of the principal types are essential. No one type of lender is capable of fulfilling the needs of all consumers. Together the principal lenders have brought respect to the industry, and competition among the major types of lenders has forced greater efficiency within the industry.

Loan Characteristics

The two most important loan characteristics are the size of loans extended and the security required by the lenders. Commercial banks are primarily interested in the larger personal instalment loans, while personal finance companies make the majority of their loans in amounts of less than \$300. Loans of more than \$500 account for more than 30 per cent of the personal instalment loan activity of commercial banks but comprise less than 4 per cent of the loans made by personal finance companies. The average size of loan made by the principal consumer instalment lenders is present in Table 1.

There are many factors controlling or determining the size of loans made by the different lenders, but the most important factor for personal finance companies is the maximum loan limitation of \$300 imposed by the laws of many states. Basic economic changes that have occurred since the late 1930's emphasize the need for increasing the loan maximum for personal finance companies.

Though relatively unimportant in the final determination of the loan, the major types of security which are required by the principal lenders is interesting. Chattel mortgages on household goods were the predominant type of security accepted by personal finance companies; chattel mortgages on automobiles and wage assignments were preferred by credit unions; unsecured notes were accepted for 65 per cent of the personal instalment loans extended by commercial banks. Personal finance companies made more than 25 per cent of their loans on an unsecured basis while less than 3 per cent of credit union loans were unsecured. For the loans that were secured, foreclosures and suits were very uncommon for all of the principal lenders.

Characteristics of Borrowers of Consumer Instalment Loan Funds

The occupations, incomes, and ages of the borrowers from the principal consumer instalment lending institutions are spread over a large and varied field. However, from the data presented in the summary table, it is apparent

that commercial bankers prefer to make loans to well-established persons. This is evidenced by the major occupations represented, as well as by the monthly incomes and ages of the borrowers. Commercial banks make the majority of their loans to craftsmen, foremen, and kindred workers, and to managers, officials, and proprietors. Such borrowers have relatively high monthly incomes, and as a group are older than those in the other occupations represented.

Personal finance companies serve more widely all occupations of the civilian working population than the other

Table I

Consumer Instalment Loan Characteristics and Characteristics of Borrowers by the Principal Types of Lending Institutions, 1950-1951

	Personal Finance Companies	Commercial Banks	Credit Unions
Average Size of Loan	\$244.42	\$534.17	\$474.51
Type of Security	Per Cent	Per Cent	Per Cent
Chattel mortgages	62.74	18.25	45.74
Unsecured notes	25.62	65.27	2.66
Co-maker notes	4.18	13.15	16.48
Wage assignments	6.99	.01	29.57
Other considerations	.47	3.32	5.55
Total	100.00	100.00	100.00
Major Occupation Groups			
Craftsmen and foremen	23.73	32.22	10.81
Operatives and kindred	30.46	10.21	51.96
Laborers	11.86	.84	6.01
Clerical and kindred	8.20	13.40	20.01
Managers, officials, & proprietors	9.19	22.03	3.86
Other occupations	16.56	21.30	7.35
Total	100.00	100.00	100.00
Monthly Income			
\$00.01 to \$200	18.98	10.15	16.03
200.01 to 300	44.38	34.35	54.76
300.01 to 400	22.35	25.48	22.24
Over \$400	14.29	30.02	6.97
Total	100.00	100.00	100.00
Age of Borrowers			
Under 30	30.31	20.53	40.13
31 to 40	32.38	31.83	33.19
41 to 50	22.79	29.66	14.70
Over 50	14.52	17.98	11.98
Total	100.00	100.00	100.00
Sex of Borrowers			
Men	91.87	78.04	77.36
Women	8.13	21.96	22.64
Total	100.00	100.00	100.00
Intended Use of Loan Funds			
Consolidate over-due bills	27.24	24.70	11.03
Medical, hospital, dental	18.91	14.66	10.57
Clothing, food, rent, fuel	10.18	9.36	4.75
Home furnishings	2.69	6.76	8.90
Automobile expense	3.95	5.27	20.29
Other uses	37.03	39.25	44.46
Total	100.00	100.00	100.00

principal lenders. Consequently, the monthly incomes and the ages of their borrowers are more representative of our entire population. A large number of the loans granted by personal finance companies go to the lower income borrowers.

Credit unions make more than 60 per cent of their loans to the occupational groups designated as operatives and clerical workers. Since many young people are employed in these occupations, the average age of credit union borrowers is lower than that of borrowers from the other principal lenders. The average monthly income of the borrowers from credit unions is approximately the same as that of borrowers from personal finance companies, but it is much lower than the income of commercial bank borrowers.

As the income of the borrower increases, his standard of living rises; therefore, a larger loan is often needed. For this reason there is a definite tendency for the size of the loan to increase with the monthly income of the borrower, though not commensurately.

Conclusions

The major conclusions reached from this two-year study follow.

1. Consumer instalment lending is a necessary economic activity. In our present-day economy, the need is even greater than formerly. The average American family spends nearly all that it earns and saves little. This is largely caused by the higher standard of living among wage earners and the lower purchasing power of the dollar. More than one-fourth of our spending units have no liquid assets to fall back on in time of stress. This positive need for consumer loans will be met by someone and should be fulfilled by licensed lenders operating under state or federal supervision.

2. Consumer instalment lenders provide assistance to the family in meeting unexpected demands for cash arising from illness, accident, death, temporary loss of work, or other emergencies. The lenders also help to keep the borrower solvent or credit-worthy by consolidating overdue obligations. There are many other equally useful purposes for which loans are granted. Consumer instalment lenders assist the borrower in preserving family pride and enable him to meet obligations without losing his independence or credit.

3. Consumer instalment loans properly extended are safe investments. Although co-makers or chattel mortgages are often required, and the ability to repay the loan is determined by the borrower's income, the real security for consumer instalment loans is character.

4. Consumer instalment lenders are reputable business organizations rendering service to the family in need of credit and earning a legitimate business profit for this service.

5. Uniformity among commercial banks and credit unions is surprisingly lacking. This is explained by the recent entry of many of these organizations in the consumer instalment lending field. Their newness to this field also accounts for the lack of skill among the executive personnel. Because of the lack of uniformity in their operations, it is extremely difficult to draw significant conclusions in these two fields.

On the other hand, personal finance companies are very similar in their operations. The larger institutions

have been in this field for many years and their procedures are governed by more rigid laws than those of commercial banks and credit unions.

6. Personal finance companies were formerly considered the "poor man's banker." Although they still serve the lower income groups, they also serve a much wider segment of the economic spectrum. The occupations and incomes of the borrowers from personal finance companies are representative of nearly every sphere of human endeavor.

7. It is necessary that the monthly rate of charge for consumer instalment loans be high enough to permit profitable operation; however, it should not be so high that inefficient operators can survive or prosper. In those few states where the maximum rate of charge is above the amount needed to conduct a reasonably profitable lending operation, it would seem wise for the state or national association of personal finance companies to take the initiative in having the state legislatures lower the legal maximum rate. Personal finance companies would benefit by such action.

8. Under consumer loan legislation, loan limits should not be regarded as rigidly fixed, but should be considered in relation to economic conditions. In many states there is a definite need for larger loans than the legal maximums presently established.

It is evident, from intended use of loan funds reported for more than six and one-half million individual loan transactions made by personal finance companies in states with a \$300 loan maximum and in states with a larger loan ceiling, that a \$300 loan will not satisfy the consumer need today. Brief examination of basic economic changes that have occurred since the \$300 loan maximum was established in the late 1930's further emphasize the necessity of increasing loan maximums. By 1950 there was only approximately \$175 worth of purchasing power in a \$300 loan.

9. Finally, and most important, in those states that do not have special small loan legislation, there is positive and urgent need for the immediate passage of the Uniform Small Loan Law. Without proper regulatory legislation borrowers are unable to protect themselves because of their lack of resources. When loan funds are made available through legitimate lenders at fair rates of charge there is no longer any need for the consumer to patronize "loan sharks."

The study is an attempt to provide an improved insight into the operation of the principal consumer instalment lending institutions. For the particular institutions included an accurate composite picture is presented of their borrowers and of the characteristics of the loans made to them. Because only large consumer instalment lenders were included, it is impossible to determine how representative the sample is of the activity of smaller organizations. All evidence tends to indicate that the sample is representative of the smaller personal finance companies and credit unions since both specialize in this one field of finance. On the other hand, it is doubtful that the sample is representative of smaller commercial banks. As a group, they are much more conservative than the banks included in this study. Each of the commercial banks studied had a separate instalment loan department and considered this phase of its banking to be important.

Microfilm \$3.15; Xerox \$10.80. 241 pages.

1. For purposes of the study, the most important distinction between consumer instalment loans and personal instalment loans is that the former term includes loans made to individuals to purchase automobiles whereas the latter term does not include automobile loans. The Federal Reserve Board and the American Bankers Association make the same distinction.

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OKLAHOMA'S STATE DEBT

(L. C. Card No. Mic 59-2072)

Jerry Peyton Simpson, Ph.D.
The University of Oklahoma, 1959

Major Professor: Jim E. Reese

Annual data on state indebtedness are available for most of the period of Oklahoma statehood, but there is no compilation of statistics on aggregate state debt financing or any legal history of public borrowing covering the entire half-century. The major purposes of the study were to trace the growth of Oklahoma's long-term state debt from 1907 to 1956 and to evaluate the debt policy of the state. Most of the material was compiled directly from primary financial and legal sources.

The original constitutional debt limit of \$400 thousand was effectively nullified by Oklahoma Supreme Court decisions exempting funding obligations and nonguaranteed revenue bonds from the restriction. In 1941 the electorate adopted a "budget-balancing amendment" which limits debt issuance to \$500 thousand a year unless additional obligations are approved by the voters. Subsequently, however, the Court reaffirmed the doctrine authorizing nonguaranteed debt financing.

Over the fifty years of statehood, seventy-six original long-term debt issues were floated by state officials and the governing boards of state agencies and institutions. These issues totaled approximately \$290 million. General obligations, payable from taxes, constituted 40 per cent of this amount; the remainder consisted of revenue bonds, secured by the earnings of debt-financed facilities. The functions of resource development, funding, public construction, and toll roads accounted, respectively, for 11 per cent, 22 per cent, 31 per cent, and 37 per cent of the total original debt floated during the period. Refunding issues totaled about \$39 million.

Until the late 1930's the volume of borrowing bore little relation to the growth of state expenditure. In the last two decades, though, aggregate debt has risen in general correspondence with the expansion of state fiscal operations. Over 70 per cent of all long-term debt issued in state financial history has been floated since the budget-balancing measure went into effect.

The bulk of postwar flotations has consisted of revenue bonds. Such obligations constituted four-fifths of the gross state debt of \$204 million outstanding in 1956. Nonguaranteed debt financing has proved relatively costly and difficult to control.

It is recommended that agencies and institutions issuing revenue bonds be required to submit detailed reports on

their debt operations and that state fiscal officers compile continuing series of data on aggregate state debt service requirements. The creation of a central bond commission is also suggested. A final recommendation is that the constitutional debt controls be revised to permit the issuance of a greater volume of general obligations.

Microfilm \$4.80; Xerox \$16.00. 373 pages.

ECONOMICS, HISTORY

DEVELOPMENT OF THE IDEA OF EUROPEAN ECONOMIC INTEGRATION

(L. C. Card No. Mic 59-902)

Andrew Imrik, Ph.D.
St. Louis University, 1958

Supervisor: Boris Tschboldin Al Bakri

The political nature and dynamic character of European economic integration almost necessarily make a study of the development either too theoretical or too empirical. The procedure followed in this study is largely empirical, and the material is organized (1) to show the development in its historical setting, (2) to present basic statistical facts, and (3) to interpret and analyze the workability of the projected idea with reference to the modern theory of customs unions with particular emphasis on current developments.

The idea of economic integration in Europe is by no means new. Regional customs union movements of a century furnish the background for historical study of materialized or projected cases revealing many different forms and types of integration efforts. Such experience suggests that a customs union of European nations is possible and sound but many practical problems are involved in economic integration.

Attempts to integrate Europe before World War II failed, as no European country was ready for the implementation of a supranational authority. At the end of the War the situation changed radically because of structural changes experienced in Europe. Since that time, institutionalized economic and financial cooperation has advanced to a remarkable degree. In addition to the more general institutions, there have been successful attempts to form a more compact and far-reaching economic union among a limited number of countries as a nucleus of further all-European integration in the economic rather than the political sphere. Attempts, made since the last war, have shown that it is necessary, in order to achieve an economic union in Europe, to go further than voluntary cooperation agreements without surrender of sovereignty, exemplified by the Organization of European Economic Cooperation; or a transfer of sovereignty limited to particular branches of the economy, such as the European Coal and Steel Community.

There is no doubt that the conclusive establishment of the European Economic Community (Common Market) as a maturing phenomenon, and progressive negotiations for an adjoining Free Trade Area are a most significant step toward the economic and possibly political integration of

Free Europe--not to say the most decisive step that has been taken for many years. In addition, by all the laws of logic and lessons learned from the experience of previous developments, this new way of achieving unity is the organic, and therefore sensible, continuation of a long-run integration process in Western Europe.

In conclusion, one may anticipate the success of the economic union; however, there are severe difficulties which have to be faced to achieve the final goals pursued by the union. The cardinal problem connected with the formation of an economic union between sovereign states is twofold:

1. Economic: The feasibility of raising standards of living by the formation of a single, integrated market for the products of the members of the economic union and the implications of such action for the domestic economic and social policies of the countries involved.

2. Political: It is conceivable that political and economic integration are interdependent and it is doubtful that one could be achieved without the other. Going through the motions of carrying out economic integration will not necessarily produce political integration of Western union, although it may speed the process if initiated and propelled by other forces.

Microfilm \$2.90; Xerox \$10.00. 224 pages.

THE COLLECTIVE FARM ECONOMY OF THE SOVIET UNION, 1933-1936, WITH SPECIAL EMPHASIS ON OUTPUT, INCOME, AND GOVERNMENT POLICIES

(L. C. Card No. Mic 59-1818)

Arcadius Kahan, Ph.D.
Rutgers University, 1959

Major Professor: Dr. Max Gideonse

Collectivization of agriculture in the Soviet Union accompanied the beginning of the accelerated, centrally planned industrialization program. Collectivization had a number of repercussions of an economic character which can be described, quantified and analyzed. Viewed against the background of Soviet agriculture in general, the following hypotheses concerning the performance of the collective farms during the period under investigation were promulgated: The organizational framework of the collective farms could not have encouraged any increase in labor productivity or efficiency in the allocation and use of resources. The existing system of planning and of government controls prevented the collective farms from behaving as profit maximizing enterprises. In the absence of any substantial income incentives for the farmers, the volume of output was likely to decline in spite of the expansion of the area sown and introduction of modern machinery. The government policies applied in the process of stimulated industrial growth have led to a decrease in the level of income of the farm population.

Available evidence points to the following conclusions: The collective farms, contrary to the official definition, were not cooperatives in their organization structure. Instead, the collective farms were the base of a pyramid of authority, in which the power of decision was reserved for

state institutions. Strengthened by law, the collective farms were able to fulfill their role as production units and facilitate the extraction of high (in terms of output) taxation-in-kind by the state from the agricultural sector of the economy. The collective farm management succeeded in increasing the labor inputs in agriculture of the collective farm members, in comparison with the preceding period, but failed to stimulate a higher level of labor productivity (measured per unit of time). Subordination of the collective farms to the demands of the state plan resulted in a wasteful utilization of available resources on particular farms, and in the collective farm economy in general. Continuous state interference prevented the collective farms from behaving as profit maximizing enterprises.

The period under investigation was marked by a deficiency of investment in agriculture, with the exception of investment in machinery and equipment. However, this increase in mechanization was insufficient to raise the level of output and productivity. The establishment of Machine Tractor Stations, which owned and controlled the operation of all agriculture machinery, resulted in the uneconomic use of the existing stock.

The level of gross agricultural output during 1933-36 was below the output level of 1925-1928, both in absolute terms and on a per capita basis, the outstanding changes in the composition of output being a decrease in livestock and grain and an increase in industrial crops. The growth of the collective farm output during this period was a relative one; it occurred at the expense of the decrease of individual farming. The distribution of agricultural output reflected the over-all economic goals of the planners. The share claimed by the state and acquired at low nominal prices steadily increased, regardless of the fluctuations in the level of gross output.

The decrease in income of the collective farm members of at least 30 per cent (when compared with the income level of the peasants during the 1920's) was due chiefly to the government policies of capital formation and income redistribution. Lack of incentives, low level of managerial experience, limitations upon mobility, and state controls over the collective farms have prevented a recovery of agricultural output and income.

The existence of the collective farmers household plots and private livestock and the legalization of collective farm market trade enabled the peasants to survive through the period, which was marked by a decrease in home consumption of agricultural products, and compensated for some of the impacts of monetary inflation.

Microfilm \$4.45; Xerox \$15.00. 348 pages.

ECONOMICS, THEORY

A STUDY OF THEORIES OF RELATIVE SHARES

(L. C. Card No. Mic 59-2227)

Paul Davidson, Ph.D.
University of Pennsylvania, 1959

Supervisor: Sidney Weintraub

This study entails a systematic analysis of the macro-distribution theories relating (1) labor value (Ricardo,

Marx), (2) marginal productivity (Clark, Marshall, Wicksteed, Cobb-Douglas), (3) monopoly (Kalecki, Mitra), (4) aggregate demand (Keynes, Boulding, J. Robinson, Kaldor), and (5) aggregate supply (Weintraub) to relative shares. The emphasis throughout is on the concepts and analytical procedures which, in the different theoretical systems, are germane to a theory of relative shares. Comments are advanced on the consistency of the assumptions and the reasoning involved in the analysis, and the empirical applicability of the systems.

Finally, in the light of concepts brought forth in this dissertation, the theory is extended to examine the effect of international trade on macro-income shares. The Stolper-Samuelson model (Review of Economic Studies, 1941) is translated into aggregate demand and aggregate supply functions. This approach allows the relaxation of the Stolper-Samuelson assumption of a constant level of employment, and it underscores the importance of price-level phenomena, the elasticity of productivity, and the composition of output in determining relative shares. It also indicates that, contrary to the Stolper-Samuelson conclusion, trade need not reduce the absolute share of labor in a labor-scarce economy. It also indicates the possibility of introducing the foreign-trade multiplier and its repercussions into the model.

Microfilm \$2.90; Xerox \$10.00. 221 pages.

EXTERNAL CAPITAL IN PUERTO RICO'S INDUSTRIAL DEVELOPMENT

(L. C. Card No. Mic 59-2002)

Paulino Alog Ballesteros, Ph.D.
University of Illinois, 1959

The main purpose of this study is to investigate the role of, and some specific problems associated with, the inflow of Mainland United States capital in the industrial development of Puerto Rico since 1942.

It is evident that the process of industrial development in the Island has been given a powerful stimulus and momentum by the sufficient inflow of both Mainland private capital and the various Federal monetary aids. These

Mainland capital aids have been mainly responsible for the rapid rate of gross capital formation at a ratio of gross Insular product from 2.6 per cent in 1940 to 21 per cent since 1956. The expansion of one of the most highly developed socio-economic overhead capital structures among the underdeveloped areas was financed almost completely by mainland United States private portfolio investments and the various Federal monetary aids. On the other hand, industrialization was made possible chiefly by the migration of over 500 Mainland manufacturing industries, about 44 per cent of which were in the textile-apparel category. The inflow of United States direct private investments in recent years has reached a yearly rate of over \$55 million, while the total cumulative investments since 1954 have exceeded similar United States investments in most Latin American countries.

Industrial activity has developed sufficient diversifications so that it appears to be a self-sustained and expanding process. These United States enterprises, which migrate as a complete package with their own sales organization, have laid some basis for imparting technology, skills, and other requisite industrial behaviours, and values. These constitute some of the more powerful built-in industrial expansion potentials of the Island economy derived from the inflow of direct private Mainland capital investments.

Although Puerto Rico's deterrents to capital inflow and industrialization are starkly numerous and similar to other areas, complicated by a limited land area, an almost absolute lack of natural resources and one of the highest population rates of growth, it has powerful attractions. These inducements derive mainly from its unique position in the larger United States economic and political complex. The usual "risks peculiar to foreign investments" are therefore minimized for Puerto Rico. These, especially the free access to the vast Mainland market and the "cheap" labor, constitute two of the Island's primary industrial locational attractions. Direct industrial stimulants similar to those used in other countries and in the United States complement these inducements to external private capital inflow. They seem, however, to have doubtful value, except for the training program. Nevertheless, they may have some minor secondary influence on the migration of the smaller firms, especially in the needlework apparel category.

Microfilm \$3.25; Xerox \$11.20. 251 pages.

EDUCATION

EDUCATION, GENERAL

AN INVESTIGATION OF AN IN-SERVICE DISCUSSION GROUP'S INFLUENCE UPON TEACHER PARTICIPANTS' EXPRESSED ACCEPTANCE OF THEIR ADOLESCENT STUDENTS AND THESE STUDENTS' PEER ACCEPTANCE

(L. C. Card No. Mic 59-2524)

James Edwin Beasley, Ed.D.
University of Maryland, 1958

Supervisor: Dr. Hugh V. Perkins

Purpose

The purpose of this research was to ascertain changes toward greater teacher acceptance of students and the increased acceptance of each other which take place as these teachers participate in a junior high school faculty discussion group. Changes in expressed teacher acceptance of adolescent students and in adolescent peer acceptance between October and April were analyzed. Adolescent peer acceptance was studied relative to grade level, sex of chooser, and sex of chosen.

Procedure

Peer acceptance data were secured from adolescents in fifteen randomly selected junior high core curriculum classes using the Cunningham social distance scale. Teacher data relating to acceptance were secured through administering the Eberman Q sort. Tape recordings and anecdotal records of weekly faculty discussion group meetings provided further data on acceptance and data on problems of core teaching. A framework was developed for categorizing teacher statements in terms of content, insight, and acceptance.

Hypotheses

The general hypotheses tended by this study are as follows:

1. Regular teacher participation in an in-service study group which is designed to improve understanding of adolescents and to solve classroom teaching problems will increase significantly these teachers' expressed acceptance of their adolescent students. Conversely, teachers who do not participate in this group will not increase significantly in expressed acceptance of their students.
2. Peer acceptance in classrooms of teachers expressing high acceptance will increase. Similarly, peer acceptance among adolescents will decrease in classrooms of teachers expressing low acceptance.
3. Adolescent peer acceptance with respect to boys' acceptance of girls, girls' acceptance of boys, boys' acceptance of boys, and girls acceptance of girls will increase significantly as these adolescents progress through junior high grades.

Findings

1. The results of this study reveal that there is no significant difference between participants and non-participants of a faculty discussion group in their acceptance of adolescents as measured by the Q sort.
2. Adolescent peer acceptance of each other does not differ significantly when classrooms of teachers with high acceptance are compared with classrooms whose teachers register low acceptance.
3. Adolescents in grades seven, eight, and nine do not increase in their acceptance of adolescent peers. However, it was found that ninth grade girls' acceptance of ninth grade boys was significantly greater than seventh grade girls' acceptance of seventh grade boys.
4. Boys as a group irrespective of grade level were significantly more accepting of their adolescent peers than were the girls as a group.
5. In all grades the greater acceptance by both boys and girls of members of their own sex group was significant at the 1 per cent level.

The implications of these findings for school administration, teacher education, core curriculum, and further research are discussed.

Microfilm \$2.45; Xerox \$8.60. 186 pages.

CHILDREN'S PERCEPTIONS OF SELECTED TEACHING ACTS

(L. C. Card No. Mic 59-1750)

Arthur Carin, Ed.D.
University of Utah, 1959

Chairman: Dr. Marie M. Hughes

STATEMENT OF PROBLEM

The University of Utah in conjunction with the Provo School District conducted research whereby a code was formulated which assigned a function to each teaching act of the classroom. However, certain acts to which functions were assigned did not show sufficient responses from children to attest to the validity of the assigned function.

These acts were selected for study in this investigation.

The main purpose of this investigation was to discover fifth graders reactions to selected teaching situations as coded by the University-Provo Research. Answers to two questions were sought.

1. Do children perceive selected teaching acts as performing the same function as that assigned by the University-Provo Code?
2. If a divergence was discovered, what was its scope and under what conditions was it found?

A second purpose of this investigation was to acquire additional understanding of children's perceptions of the teaching-learning situation.

PERCEPTION

Perception was defined in this study as the process of organizing and interpreting the sensations that the organism receives from external or internal stimuli. Moreover, perception involves previous experiences of the individual, resulting in an organization of sensations, values, and expectations, through which the present experiences are screened. This approach generally is called phenomenology.

In this investigation written responses of the children were accepted as their perceptions of the teaching acts.

PROCEDURES IN THIS RESEARCH

Instruments. A projective device, The School Situation Perception Test, was built for this investigation to acquire information of children's reactions to selected common classroom situations. This instrument presented in story form eight teaching acts, which had been assigned functions by the University-Provo Code; each of these eight teaching acts was presented in two story situations in such a manner as to arouse identification by the children responding with the children and situations portrayed in the story. Following each story was one question or two questions intended to secure clues to children's perceptions of the situation. Four common classroom situations were added to determine children's responses to them.

These story situations were selected from the actual records of teaching compiled by the staff of the University-Provo Research, because of their commonness of occurrence in the classroom. Refinements and occasional rewordings were incorporated as a result of a pilot study, and the instrument finally evolved was The School Situation Perception Test, by Hughes and Carin.

SUBJECTS IN THE INVESTIGATION

Four hundred eighty-four (484) fifth grade children responded to the projective device in this investigation. These children were from fifteen (15) different classrooms in five (5) schools in the middle-middle and upper-middle residential area of Salt Lake City. These classes comprised all the fifth grades in these five schools.

Microfilm \$4.65; Xerox \$15.60. 364 pages.

A SURVEY OF ART ACTIVITIES, MATERIALS, EQUIPMENT AND ART PRODUCTS IN THE ELEMENTARY SCHOOLS OF PENNSYLVANIA

(L. C. Card No. Mic 59-2393)

Eleanor Margaret Dillinger, Ed.D.
University of Pittsburgh, 1959

This study is a survey of certain aspects of art in the public elementary schools of the state of Pennsylvania. It is based on the elementary classroom teachers' evaluation of the following factors: the importance of various art activities; the frequency of use of various art activities; the frequency of use of various art materials; the availability of various kinds of equipment; the frequency with which children make various kinds of art items.

In 1914, Farnum reported a study called "Present Status of Drawing and Art in the Elementary and Secondary Schools of the United States." Since that date no study of its kind has been made.

In 1952, Hastie made a nation-wide study called, "Current Opinions Concerning Best Practices in Art for Elementary School Teacher Preparation." His findings show the consensus of his study group to be in close agreement with the beliefs of the leading art educators of the day.

In 1953, Beelke made a national study of certification requirements for teachers of art which showed that elementary classroom teachers are so poorly prepared to teach art that they are using procedures which are harmful to childhood growth and development.

This study was developed as follows: The factors used for evaluation grew out of previously related studies, the literature on art education, the literature on child growth and development, and the investigator's long experience as an art supervisor and teacher in the elementary field. The inventory used to collect the data was made by the investigator and refined for final use in a preliminary study by application to a random sample of 50 elementary classroom teachers. The refined inventory was sent to 821 randomly selected elementary classroom teachers of the Jointure, Non-Jointure and Second-Class Non-Jointure schools of the state of Pennsylvania, of which 578 useable ones were returned.

The findings reveal an extreme deficiency in art education in the public elementary schools of Pennsylvania. The study shows that the thinking of each study group reflects very strongly the beliefs which prevailed in art education in the beginning of the twentieth century. It reveals the fact that an extremely high percentage of the elementary teachers do not consider creative art activities to be of much importance to the children.

The study shows that a very high percentage of the children engage in very few art activities. It shows that, for the most part, the activities in which they do engage are not broad enough in scope and are not conducive to natural free expression and wholesome growth. The study shows that the art experiences of a very high percentage of the children are confined to coloring-in, copying, and drawing.

Many of the needed materials are reported not used or not available. In only a small percentage of the cases does the study show that the children actually use the kinds of materials which present-day art educators believe to be essential for proper child development. The study also shows that the schools have a very meager amount of necessary equipment.

The art products made by the children are reported to be extremely few and the study reveals that even the few that are made are largely of the traditional kind.

The study shows that the children of the Jointure and Second-Class District Schools fare considerably better than do the children of the Non-Jointure Schools, yet the children of all the study groups appear to have extremely inadequate experiences in art education.

Microfilm \$2.25; Xerox \$8.00. 172 pages.

**A CRITICAL ANALYSIS OF THE MAJOR
ARGUMENTS AGAINST THE TEACHING OF
RELIGION IN THE PUBLIC SCHOOLS**

(L. C. Card No. Mic 59-2289)

John George Kramer, Ph.D.
The Ohio State University, 1953

There is a controversy of philosophic interest currently engaging the attention of thoughtful and sincere people who are interested in the welfare of our school children. The question with which this controversy deals is that of the place of religion in the curricula of our public schools, and the two sides to the controversy are sharply divided on this question. There are some philosophers of education who argue that religion has no place in the public school system, while, on the other hand, there are some religionists who argue that the welfare of the child demands that religion be taught, along with secular subjects, as a regular part of the public school curriculum. The circumstance that education in the United States is a function of the state introduces into the controversy the factor of the relation of church to state, a factor which permits each of the contestants in the controversy to rely on the Bill of Rights, as expressed in the First Amendment to the Federal Constitution, to support his argument. The presence of two sets of arguments, the educational and the religious, claiming contradictory conclusions and making use of legal arguments which depend on contradictory interpretations of the First Amendment constitutes a philosophic problem involving the validity of the arguments presented by the disputants.

The issue at stake is the freedom of the mind, and the arguments of each of the contestants implicitly affirms freedom of the mind to be the fundamental issue. This is evidenced by the consideration that each side calls to its support the specific freedoms enumerated in the First Amendment to the Constitution, freedoms which the writer holds to be particular expressions of the universal freedom of the mind. The cogency of the legal argument depends, in large part, on the interpretation of the meaning of the language of the First Amendment; consequently, a review of the private and public writings of the framers of that Amendment is necessary in order to obtain an adequate comprehension of the intentions of the men who framed the Amendment, and of the purposes which they sought to achieve by amending the Constitution. A similar task is revealed by the ambiguity and obscurity of meaning displayed in the use of the term "religion"; consequently, one of the essential parts of the problem is the clarification of terms such as "religion," "sect," "education," "freedom," and the like.

The three interrelated phases of the problem were brought into sharp focus in 1947, when Mrs. Vashti McCollum, a taxpayer and the mother of a school child in Illinois, requested that the board of education of her residence school district abandon the "released-time" program of religious education which it had authorized. The refusal of the board to comply with her request led Mrs. McCollum to institute suit in the lower courts of the state to compel the board of education to cease the practice on the ground that it violated the Illinois constitution, as well as the school code of Illinois. The judgment of the lower Court held that no such violation had occurred; Mrs. McCollum, therefore, appealed to the Supreme Court of Illinois to

review the judgment of the lower court. Her appeal was granted, the review was made, and the decision of the Illinois Supreme Court affirmed the judgment of the lower court. In the appeal to the Supreme Court of the state Mrs. McCollum included as part of her complaint the invasion of her rights as a citizen of the United States by virtue of a violation of the freedom-of-religion clause of the First Amendment to the Federal Constitution. This inclusion permitted an appeal to the United States Supreme Court. This appeal was made following the decision of the Illinois Supreme Court. Following argument by the attorneys for both sides of the case, the high Court of the nation reversed the decision of the Illinois Supreme Court, and issued a writ of mandamus ordering the defendant board of education immediately to adopt and enforce rules and regulations prohibiting all teaching of, and instruction in, religious education. The issuance of this writ of mandamus was the result of the plea of Mrs. McCollum to the high Court to prohibit all such teaching. She made this sweeping appeal to the Supreme Court on the basis of her avowed atheism, and her argument that her rights had been invaded by the released-time program of religious education was made on the grounds that any definitive religious teaching would violate her freedom of religion as an atheist.

The purpose of the dissertation is to make a critical examination of the arguments against the teaching of religion in the public schools in order to determine their validity or invalidity. The criteria used to judge the validity of the arguments were those of consistency, coherence, completeness, and cogency. It was necessary to contain the investigation within reasonable bounds; consequently, it considers, as the title indicates, the major arguments against the teaching of religion in the schools, for example, the argument of the philosophic Materialist; the arguments of prominent educators, such as John Dewey, Herman Harrell Horne, Frederick Breed, the Reverend William J. McGucken S.J., and Rabbi David deSola Pool. These men are representative of particular philosophies of education and have been chosen to represent these philosophies because they are able and competent spokesmen for them.

The dissertation is structured so that the problem is first delineated; then the three groups of arguments, the legal, the religious, and the educational, are successively presented, followed by a critical evaluation of each in the same order. Next, a chapter is devoted to indicating the relevance of these arguments to the fundamental issue, freedom of the mind. The dissertation is brought to a close by a summary and the writer's seven conclusions:

(1) Justice Felix Frankfurter's argument that the public school must be kept strictly secular, and that the "religious indoctrination" of the child must be delegated to the home and the church of the child's choice, is both logically inconsistent and socially divisive. His argument is predicated on the assumption that education can do nothing about eliminating divisive conflict among the sects, an assumption which is unwarranted. It is logically inconsistent because it advocates subjecting the child simultaneously to the contradictory processes of education and indoctrination. It is socially divisive because it advocates the legally protected continuation of dogmatic sectarian indoctrination, a process which has been found to be the principal cause of conflict and strife. (2) The fundamental meaning of the First Amendment to the Constitution is to guarantee freedom of the mind in the full sense of the word, freedom from restraint and freedom for growth and

development in all areas of intellectual discipline, including religious discipline. (3) Atheism is a sectarian religious position by virtue of the relation of negation, a logical relation which ties it necessarily and inevitably to theism. (4) Because atheism is a sectarian religious position, the Supreme Court established a national religion in direct violation of the First Amendment. It did so because it admitted the validity of the appellant's (Mrs. McCollum) argument that atheism should be the official religious position by virtue of a writ of mandamus which joined the power of the civil government to a particular religious sect for the purpose of enforcing the doctrine of that position on the citizens under its jurisdiction. (5) In validating the argument to prohibit all teaching of religious education, the Supreme Court made this argument available to the opponents of the appellant's position; that is, it made the argument valid that atheism, too, shall be prohibited from being taught since it is a sectarian religious position. From this conclusion it follows that universal silence is imposed on us, since there is no phase of human experience that is irrelevant to religion, either *pro* or *con*. (6) The educational arguments are directed against the teaching of sectarian dogma and are aimed against the performance of ritual and ceremonial in the schoolroom—these objections are very validly raised and supported. These arguments, however, presuppose that there can be no such thing as religion in the universal sense of the term, the sense in which religion could transcend the particularity of sectarian dogma. The writer's conclusion is that this assumption is unwarranted, since religious education, when rightly treated, is the very antithesis of sectarian indoctrination. (7) If the goal of education is freedom of the mind, and with it the pragmatic consequence of reduction of divisive conflict and promotion of social cooperation in the body politic, then religion not only can be, but must be, taught in the public schools.

Microfilm \$4.15; Xerox \$14.00. 322 pages.

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AN INVESTIGATION OF THE RELATIONSHIPS BETWEEN PUPIL ACHIEVEMENT IN FIRST-YEAR ALGEBRA AND SOME TEACHER CHARACTERISTICS

(L. C. Card No. Mic 59-2362)

Hugh Joseph McCardle, Ph.D.
University of Minnesota, 1959

Mathematics and science have become practically synonymous in their broader meanings and their impact on our society. The importance of developing the most effective classroom instruction for the prospective mathematician-scientist is obvious.

Teacher education research, in recent years, has been increasingly concerned with the role played by a teacher's attitude in the total classroom situation. This study was an investigation of the relationship of teacher attitudes as measured by the Minnesota Teacher Attitude Inventory (MTAI) to pupil achievement as measured by tests of quantitative thinking, functional competence in mathematics, and elementary algebra achievement.

Subjects of the study consisted of all 29 teachers of first-year algebra in the 13 schools offering this course within the public school system of a midwestern city of more than 300,000 population. The pupil group included the 1,643 pupils of these teachers who did not change teachers during the school year, and who completed the fall and spring testing in 1955-56.

On the basis of MTAI scores, the teachers were grouped into high, middle, and low categories. The pupils were tested in such areas as arithmetic understanding, quantitative thinking, functional competence in mathematics, and algebra achievement.

The basic analyses of the pupil scores according to the level of the teacher attitude score were accomplished by analysis of variance and covariance. This procedure was utilized in determining whether the means of the teacher groups were equal on each of the three criterion variables, after adjusting for initial measures. When significant differences at the .05 level were found among criterion variable means after these means had been adjusted, the means were analyzed to test differences among pairs of adjusted means.

The null hypothesis, generally stated, is: There is no difference in the achievement of the pupils in first-year algebra regardless of the level of the teacher's attitude score.

The major findings follow:

1. The adjusted pupil mean on both the quantitative thinking and the functional competence in mathematics gain scores for the high teacher group was significantly higher than the adjusted pupil means for either the middle or low teacher groups (.01 level). There were no significant differences in the adjusted pupil means on either measure between the middle and low teacher groups.

2. There were no significant differences in the adjusted pupil means on the elementary algebra measure among the three teacher groups.

The pupils having teachers from the high attitude group profited most during the first-year algebra course in the areas of quantitative thinking and functional competence in mathematics. The attitude of the teacher was not significantly related to the pupil scores on the elementary algebra measure.

It would seem, however, that high group MTAI teachers are not as "textbook bound" as the middle and low teacher groups; in other words, the high teachers instruct in such a manner that their students achieved significantly greater on the quantitative thinking and functional competence in mathematics measures. These areas are highly important and not to be neglected in a first-year algebra course. Therefore, administrators and teacher education staffs should give consideration to this aspect of the findings.

The significant pupil gains by high teacher group on quantitative thinking and functional competence in mathematics may indicate that the pupil has not only achieved in algebra, but his additional achievement may reflect a classroom situation which was conducive to increased learning. The high MTAI teachers may have provided pleasant experiences, supplementary instruction, and extra motivation which are evidences of good teaching. One would certainly want a teacher of algebra whose pupils achieve successfully in quantitative thinking and mathematical understanding as well as algebraic concepts.

Microfilm \$2.75; Xerox \$9.40. 209 pages.

THE SECRETARY'S RESPONSIBILITIES AND UNDERSTANDINGS RELATED TO THE AREAS OF ECONOMICS AND BUSINESS ADMINISTRATION

(L. C. Card No. Mic 59-2300)

Mary Virginia Moore, Ph.D.
The Ohio State University, 1953

Purpose of the Study

It was the purpose of the investigator to study the secretary's responsibilities and understandings related to problems and procedures in the areas of economics and business administration. The study was concerned with answering the following questions. (1) What is the secretary's occupational need for understandings in the areas of economics and business administration? (2) How does she use her understandings in these areas? (3) Is an understanding of certain problems and procedures in these areas required in all secretarial positions?

Procedures Used

The following steps were taken toward limiting the investigation to topic areas which might be most suitable for an investigation related to the work of the secretary and which might be investigated in a personal interview. (1) Topics commonly included in introductory economics and business administration textbooks on the college level were compiled in a check-list form. (2) Authorities in the fields of secretarial training, economics, and business administration were asked to rate the topics in terms of their opinions concerning the importance of the topics in the performance of the top-level secretary's work. (3) Topics considered by the authorities to be most important to the secretary in the performance of her duties were used as the bases of investigation.

One hundred secretaries employed in 91 different business and professional organizations of various types in the city of Columbus, Ohio, were interviewed. All of these secretaries performed secretarial work for administrative or executive company officers, such as presidents, vice presidents, or managers of major functional or geographic company branches, and were employed in positions of great responsibility. The term "top-level secretary" was used in describing the secretaries interviewed.

Results of the Investigation

Major Items Investigated.—Questions pertaining to topic areas investigated were organized under the following headings: Money, Credit, and Banking; Public Finance; Risk and Insurance; Labor Problems; Business Information Analysis; Office Management; and Organization Structure of Business. Answers to interview questions related to the topics investigated were summarized in terms of 42 major items. The 42 items and the percentage of interviewees reporting responsibilities or understandings pertaining to each item follow.

Money, Credit, and Banking: Company Financing (89); Employer's Banking (57); Credit Transactions (37); Company Banking (34); and Miscellaneous Financial Enterprises (29)

Public Finance: Individual Income Taxes (47); Governmental Expenditures, Effects and Characteristics (40); Property Taxes (36); Social Security Taxes (33); Business Taxes (17); Commodity Taxes (16)

Risk and Insurance: Company Insurance, such as fire, property damage, public liability (46); Nature of Such Risks as Business Cycles, War, Weather, and Style Changes (43); Company Insurance for Employees, such as accident and health, group life, and workmen's compensation (37); Employer's Personal Insurance (37); Causes of Business Failure (30)

Labor Problems: Wages and Salaries (90); Training Employees (67); Selection of Employees (54); Labor Legislation (49); Labor-Management Relations (41); Supervising Employees (41); Laws Affecting Company, Other than Labor (39); Employee Grievances (38); Job Studies (27); Transferring and Promoting Employees (25); Employee Rating (23); Employee Separations and/or Disciplinary Actions with Employees (17); Social, Recreational, and Athletic Services for Employees (12)

Business Information Analysis: Company Publications and Reports (97); Bookkeeping, Accounting, and Business Statistics (92); Sources of Business Information Other than Company Records and Publications (85)

Office Management: Service and Communication Facilities—Correspondence, Filing, Handling Incoming and Outgoing Mail, Reception Services (100); Office Methods and Procedures (100); Office Furniture, Equipment, and Machines—Selection, Purchase, Record Keeping (98); Office Supplies—Purchasing, Requisitioning, Inspecting, Storing, and Issuing (96); Office Working Conditions—Lighting, Color, Heating, Ventilating (90); Office Layout (89); Merchandise and Materials—Purchasing, Requisitioning, Inspecting, Storing, and Issuing (9)

Organization structure of Business: Organization Structure (100); Management Meetings (51); Forms of Business Ownership—Corporations, Partnerships, Individual Proprietorships (48).

Responsibilities Reported by Interviewees.—Responsibilities reported by 30 per cent or more of the secretaries interviewed relating to problems and procedures in the areas of economics and business administration follow:

Responsibilities	Per Cent Reporting
Sees that office procedures are carried out as planned	100
Composes letters for employer	98
Improves methods of performing individual office tasks	96
Prepares reports	95
Files materials	88
Prepares memos	86
Interprets company policies and procedures to employees	82
Obtains information from sources of business information other than company records and publications	82
Organizes and presents numerical data	73
Sets up filing procedures	73
Requisitions office supplies	67
Makes decisions concerning selection and purchase of office machines	65
Stores office supplies	65
Collects numerical data	64
Makes recommendations concerning selection and purchase of office machines	61

Makes bank deposits for employer or company	61
Answers or directs telephone inquiries to proper persons in organization	59
Maintains desirable heating and ventilating conditions in office	57
Makes recommendations concerning selection and purchase of office furniture and equipment	57
Makes decisions concerning selection and purchase of office furniture and equipment	56
Reconciles bank statements for employer or company	56
Writes checks for employer or company	58
Designs office forms	53
Keeps bookkeeping and accounting records	51
Makes decisions concerning arrangement of office furniture, equipment, and machines	50
Analyzes numerical data	49
Writes or routes correspondence or other materials to proper persons in organization structure	49
Refers questions or problems to proper persons in organization	48
Files insurance records	48
Keeps tax records	46
Keeps insurance records	45
Places orders for office supplies	44
Handles outgoing mail for own office	43
Serves as receptionist for employer	43
Locates and contacts sources of office supplies	42
Inspects office supplies received	42
Supervises one or more office employees	41
Sees that office supplies are delivered (follow-up letters, telephone and telegraph messages, etc.)	40
Prepares tax reports	40
Makes recommendations concerning arrangement of office furniture, equipment, and machines in the office	39
Makes payment of taxes	39
Makes insurance premium payments	39
Interviews prospective employees	37
Makes recommendations concerning colors used on office walls and in office furnishings	37
Makes recommendations concerning provisions for sufficient and proper light	36
Assembles cost data	34
Handles incoming mail for own office	34
Calculates taxes	33
Interprets numerical data	33
Keeps wage and salary records for employees	31
Prepares news releases	31
Prepares or types financial reports and papers pertaining to company financing	31

Checks invoices for office supplies received	31
Establishes office procedures for company	30
Refers to budgets for information	30
Files materials pertaining to labor legislation	30

Relationship of Secretarial Responsibilities or Understandings to Size of Office Staff.—Business and professional organizations represented in the study were classified according to office size. "Very small" offices had no more than 4 office employees, "small" offices had from 5 to 25 office employees, "medium" offices had from 26 to 250 office employees, and "large" offices had more than 250 office employees.

In general, for each of the following items the percentage of interviewees reporting responsibilities or understandings decreased as the size of office staff increased: Company Insurance, such as fire, property damage, and public liability; Company Insurance for Employees, such as accident and health, group life, and workmen's compensation; Employer's Personal Insurance; Causes of Business Failure; Individual Income Taxes; Property Taxes; Business Taxes; Commodity Taxes; Social Security Taxes; Company Banking; Employer's Banking; Credit Transactions; Laws affecting Company (other than labor); Employee Separation and/or Disciplinary Actions with Employees; and Merchandise and Materials—Purchasing, Requisitioning, Inspecting, Storing, Issuing.

In general, the percentage of interviewees reporting responsibilities or understandings related to the following items increased as the size of the office staff increased: Management Meetings; Sources of Business Information Other than Company Records and Publications; Social, Recreational and Athletic Services for Employees.

The relationship between size of office staff and secretarial responsibilities or understandings related to the following items was not significant: Bookkeeping, Accounting, and Business Statistics; Organization Structure, Forms of Business Ownership—Corporations, Partnerships, Individual Proprietorships; Service and Communication Facilities—Correspondence, Filing, Handling Incoming and Outgoing Mail, Reception Services; Office Methods and Procedures; Office Layout; Office Furniture, Equipment, and Machines—Selection and Purchase and/or Record Keeping; Office Working Conditions—Lighting, Color, Heating and Ventilating; Office Supplies—Purchasing, Requisitioning, Inspecting, Storing, Issuing; Miscellaneous Financial Enterprises; Company Financing; Company Publications and Reports; Nature of Such Risks as Business Cycles, War, Weather, and Style Changes; Wages and Salaries; Labor-Management Relations; Labor Legislation; Selection of Employees; Training Employees; Transferring and Promoting Employees; Supervising Employees; Employee Grievances; Job Studies; Employee Rating; and Governmental Expenditures, Effects and Characteristics.

Conclusions

1. The top-level secretary occupies a position of great responsibility in her company. Questions and problems of vital importance related to company activities are frequently referred to her. It is essential that she either provide correct information concerning these questions and

problems or refer them to proper individuals in her organization. Complete understanding of the major functions of her employing company and the lines of authority and responsibility observed in carrying out these functions is a prerequisite for effective performance of secretarial duties.

2. Top-level secretaries have a wide variety of responsibilities related to problems in the areas of economics and business administration.

3. The size of office staff in the employing company is a determining factor in whether or not the top-level secretary assumes responsibilities related to certain problems and procedures in the areas of economics and business administration. For example, banking, insurance, tax, and credit problems are less frequently handled by top-level secretaries with each increase in the size of office staff.

4. The size of office staff has little, if any, significance in relation to secretarial responsibilities and understandings pertaining to certain problems and procedures in economics and business administration. For example, little variation was noted in the percentage of interviewees reporting responsibilities or understandings related to office management functions; the preparation of reports; business organization structure; bookkeeping, accounting, and business statistics; company financing; or labor problems.

5. The importance of responsibilities assumed and understandings needed related to problems and procedures in the area of economics and business administration to the top-level secretary cannot be described solely in terms of their frequency in secretarial positions. Only 9 per cent of the interviewees reported responsibilities related to purchasing, requisitioning, inspecting, storing, and issuing merchandise and materials. However, one secretary in an importing firm purchases all merchandise for her company, including its branch offices. All of the responsibilities related to obtaining the merchandise, as well as inspecting it upon its arrival, storing it, and issuing it to branch companies are hers. In addition, she deals directly with buyers, makes collections, does company banking, handles insurance, and handles most tax problems relating to the merchandise purchased.

6. The secretary's relation to problems in the area of economics and business administration cannot be expressed in terms of duties alone. Several interviewees stated that their understanding of certain problems investigated resulted in a better comprehension of business and employer activities, even though they had no direct responsibility in relation to the problems.

Recommendations

It is recommended that special emphasis be given in secretarial training programs to the following understandings related to problems and procedures in the areas of economics and business administration:

1. Characteristics of effective office procedures; methods of establishing and carrying out office procedures; methods of simplifying office work
2. Characteristics of different filing systems; filing principles and procedures
3. Methods and procedures necessary for efficient handling of incoming and outgoing mail
4. Correct procedures to be followed in carrying out receptionist services
5. Factors to be considered in the selection and purchase of office furniture, equipment, and machines

6. Principles to be followed for best utilization of office space

7. Environmental qualities necessary for desirable working conditions, such as effective use of color, proper lighting facilities, correct amount of light, and desirable heating and ventilating conditions

8. Factors to be considered in the design of office forms

9. Characteristics of effective business letters

10. Characteristics of different kinds of reports; methods of setting up reports; methods of collecting, organizing, and presenting numerical data in reports

11. Correct use of such sources of business information as government publications, directories, business magazines, and other publications used in business and professional organizations

12. Correct procedures to be followed in carrying out such banking duties as writing checks, making deposits, and reconciling bank statements

13. Methods companies use to obtain capital; investments made by companies

14. The nature of common records kept by business and professional enterprises

15. Factors important in supervising employees

16. Factors important in training employees

17. Characteristics of different forms of taxes; nature of records kept and reports prepared for individual income and social security taxes

18. The effects of governmental expenditures on business and professional enterprises

19. Characteristics of the major types of insurance, life, fire, marine, and casualty; different types of insurance contracts that may be purchased by individuals and business organizations

20. The nature of such risks as business cycles, war, weather, and style changes

21. Types of organization structure; importance of observing lines of authority and responsibility in carrying out company functions.

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READING EIGHTH GRADE MATHEMATICAL MATERIALS FOR SELECTED PURPOSES

(L. C. Card No. Mic 59-2059)

Vernon Earl Troxel, Ed.D.
University of Illinois, 1959

The purposes of this study were (1) to investigate relationships within and between measures of ability to read expository mathematical materials and between each of these measures and measures of general reading ability, of arithmetic achievement, and of intelligence, (2) to analyze for use in future research responses to a check list concerned with the skills used in reading each of the twenty passages of expository mathematical material, and (3) to examine the relationships between purpose for reading and estimates of difficulty and interest.

Two groups of eighth grade students read the twenty passages for one of two purposes--to find the answer to a specific question (Exercise A's) or to find the main idea (Exercise C's). Forty-five students participated in the study.

To accomplish the purposes of this study certain comparisons were made using (1) speed and comprehension scores obtained from the expository mathematical materials, scores from standardized reading and arithmetic tests, and scores from a non-language intelligence test, (2) the total number of responses to each item in the first twelve sections of the check list and the total of such responses made by certain extreme groups, and (3) the number of estimates of difficulty and interest at each possible level. Responses to questions asked in an interview following the last exercise were categorized and enumerated.

Twenty-two hypotheses were tested using the data from (1) and (3) above. The differences found in (2) above were not tested for significance.

Conclusions based on the tests of the hypotheses are as follows:

1. The purpose for reading influences the speed with which the material is read.
2. General reading ability tests measure the kinds of things measured by the Exercise C's better than those measured by the Exercise A's.
3. Those who read the expository mathematical material faster and with better comprehension also tend to achieve higher scores on the general reading ability tests.
4. The relationships between high scores on general reading ability tests and superior scores for speed and comprehension are reduced when intelligence is held constant.
5. Speed and comprehension scores on the timed passages of the Iowa Silent Reading Tests are more like speed and comprehension scores on the Exercise C's than on the Exercise A's.
6. Speed and comprehension scores on a general reading test are not necessarily good predictors of speed and comprehension for other kinds of material read for other purposes.
7. The kinds of things measured by speed and, to a larger extent, comprehension are factors in arithmetic achievement.
8. The kinds of things measured by speed and, to a larger extent, comprehension are factors in intelligence.
9. Practice without instruction on this kind of material for twenty successive school days does not produce better scores for speed and comprehension.
10. There is a tendency for faster readers to comprehend better when they are reading expository mathematical material.
11. Estimates of difficulty are influenced by the purpose for which a passage is read.
12. Estimates of interest are not significantly influenced by the purpose for which a passage is read.

The implications of the findings concerning the skills used were reported and discussed briefly.

Microfilm \$2.60; Xerox \$9.00. 200 pages.

DESIGN IN THE EDUCATIONAL FILM: AN ANALYSIS OF PRODUCTION ELEMENTS IN TWENTY-ONE WIDELY USED NON-THEATRICAL MOTION PICTURES

(L. C. Card No. Mic 59-2331)

Robert Walter Wagner, Ph.D.
The Ohio State University, 1953

The purpose of the dissertation was to find and test the meaning of what is proven, practiced, and surmised about certain elements in the design of effective educational motion pictures, and to lay a firmer foundation for present production and for future research.

The writer did not expect to find, nor did he hope to develop, a "formula" for the making of the successful educational film. The film experience is dynamic, not static, in quality. The rhetorical elements in any film interact with each other, with the nature of the audience, and with the time and circumstances of showing. This makes it difficult to isolate any single factor for study and then to combine it with other production elements in a "master design."

However, since a growing body of subjective and objective evidence on educational film production does exist, it seemed reasonable to check this evidence against production techniques found in a group of films which have found wide acceptance and use by teachers and leaders of school and adult groups. Such analysis, it was believed, might lead to new insights on what makes a film popular, and to a better understanding of the whole process of film communication.

The springboard for the investigation was provided early in 1953 with the publication of the Educational Film Library Association's "Report On Most Used Films."¹ This was a survey of the membership of the Association to discover the titles of the ten or fifteen films most requested by school and adult groups. From a total of 134 returns, in which the titles of 932 films were mentioned, 9 films were found to be the most popular with school groups, and 13 were found to be the most popular with adult groups.

Films reported as most used in the school field were: Adventures of Bunny Rabbit; Colonial Children; Gray Squirrel; The Loon's Necklace; Autumn on the Farm; Land of Liberty; The River; Common Animals of the Woods; Farm Animals.

Films reported as most used by adult groups were: Preface to a Life; The River; Children's Emotions; Overdependency; America the Beautiful; Angry Boy; Human Reproduction; Learning to Understand Children; Feeling of Hostility; Broader Concept of Method; Brotherhood of Man; Boundary Lines; Animals Unlimited.

One film, The River, appeared in both lists, so that while for comparative purposes a total of 22 films was considered, generalizations on the entire list of films, regardless of the level for which they were intended, were made on the basis of the 21 individual titles.

The selection of specific elements for study in these films was guided by the following criteria: (1) the elements had to be those which could be identified and defined with reasonable accuracy; (2) they had to be elements on which some experimental evidence existed against which the present findings could be checked; (3) they had to be elements of practical concern to the producer of educational films.

On this basis, the 21 most used films listed by the Educational Film Library Association were analyzed with respect to (1) structural organization, (2) audience involvement, (3) level of verbalization and rate of delivery (4) camera interpretation, (5) color, (6) music and sound effects, (7) optical and special effects, and (8) animation.

Scripts and teacher's guides were obtained for 16 of the 21 films, so that in these cases the analysis proceeded from script as well as from screen. Each film was viewed at least three times, and various sub-studies were involved in the determination of each of the factors mentioned above.

The results of the film analysis were then compared (1) with empirical (i.e. non-experimental evidence) and (2) with experimental evidence on the same elements.

In general, these productions reflect a variety of approaches to film making. Although Encyclopaedia Britannica Films produced or now distributes seven of the nine school films studied, and McGraw-Hill Text Films is responsible for six of the thirteen adult films listed, documentary film makers like Pare Lorentz, and Willard Van Dyke, major studios like Warner Brothers and M.G.M., and seven different independent commercial film production organizations are also represented.

The fact that approximately three-fourths of these films are more than five years old, one-third having been produced more than ten years ago, may simple prove that educational films are slow to get into wide circulation. It may also reflect the teacher's habit of ordering the same film, and relying on the "tried and true." On the other hand, it may mean that these films have been found to be worthwhile by teachers who have used them over a period of years.

Certainly, one reason for the wide popularity of these films would seem to be that they meet broad subject matter needs. The school films are mostly in the primary area, six of the nine films listed dealing with animals. Ten of the 13 films in the adult group are based on social or personal problems, and at least seven are partially in the field of mental hygiene. All are broadly educational rather than narrowly instructional.

With regard to specific production elements—

1. The school films tend to be shorter than the adult films, the former having an average running time of fifteen minutes, the latter an average running time of twenty-two minutes.

2. The school films average 92 scenes per reel, with an average scene length of 4.1 feet, or about seven seconds. The adult films average 76 scenes per reel, with an average scene length of 6.0 feet, or ten seconds (The extensive use of dialogue sequences tends to increase scene length in pictures in the latter group).

3. Although introductions, summaries, and repetition have been found to be important organizational factors helpful in promoting memorability, only four of the 21 films studied include an introduction, only two contain a summary, and in only six are various forms of repetition — verbal, pictorial, or musical — used to any extent.

4. As measured by the Dale-Chall Formula for Predicting Readability, the narration of the school films ranges from grades four to ten, with an average between the fifth and sixth grades. If *The River*, and *Land of Liberty*, both of which were originally intended for theatrical release, are excluded, the "readability" level of the narration in films most used by schools is found to be grade four.

The level of narration in the adult films ranges from

the fourth to the tenth grade, with an average between the seventh and eighth grades. In this connection, the average sentence length in the school films is approximately 7.8 words, that of the adult films about 21.0 words.

As measured by a reliable readability formula, therefore, the narrations of these films fall at or near the theoretical reading level of the audience for which they were intended.

5. The rate of verbal delivery, in terms of number of words spoken by the narrator, ranges from 90 to 155 words per minute in the school films, and from 75 to 155 words per minute in the adult films. The total average for all films falls below the 130 words per minute commonly considered to be a "normal" rate of speech.

6. All of the films in both groups contain one or more elements related to audience involvement (i.e. "identification" "familiarity," "anticipation," "participation," "dramatic structure").

The adult films, in general, contain more of these elements than the films intended for school use, a finding which follows logically from the fact that at least eight of the 13 adult films deal directly with emotional situations and are intended to influence attitudes.

7. Straightforward, simple camera interpretation on the long shot, medium shot, close-up pattern characterizes the school films designed for the elementary level. In the adult films, the camera is used more interpretively — angle, composition, and lighting being important cues to the meaning of the scene. The technical quality of the photography in all films is from good to excellent.

8. Color is found in only six of the 21 films studied, two of these being on the school list, four on the adult list. Color appears to be used (a) representationally—to show "what it looks like," and/or (b) symbolically—to show "what it means."

9. Animation is found in six of the 21 films, being used for a wide variety of purposes and in a variety of techniques. The work of well-known animation artists and technicians like Phillip Stapp, Norman McLaren, and Nathan Sobel is represented in these films.

10. Sound effects are used in all but one of the 21 films. Music is found in only three of the nine school films, but is used symbolically as well as representationally in 10 of the 13 adult films. The work of a number of experienced composers of film music, such as Virgil Thomson, Gene Forrell, Robert Fleming, and Karol Rathaus, is found in this group of films, indicating the integral importance of music in the design of at least four of the films investigated.

11. Optical effects appear in the body of all films except one. The most commonly used optical effect is the dissolve, a total of 310 of these effects appearing in all pictures. The fade (in and out) is found 126 times. The wipe is infrequently used, only six of these effects appearing in the total of 21 films. All optical effects are used conventionally to symbolize the beginning and ending of an idea, and to effect transitions involving changes of time, place, or situation.

12. Two of the school films and five of the adult films contain special effects such as "zooms," double-exposures, montages, and other purely cinematic devices. Although such effects are noticeably absent in films designed specifically for the lower grades, they appear in some of the adult films where they are used to express abstract concepts and ideas.

The analysis of film design is a type of consumer

research which might well be continued on the basis of regular tabulations of most used films. We need to know what kinds of films are popular. More importantly, we need to know what makes them popular. Such analyses must be evaluated, however, in the light of the professional judgments of film makers, the practical experience of teachers, and the tested findings of research workers in the field of communication.

A close agreement is found between the design of 21 widely used films, and certain empirical and experimental evidence. Although, at the moment, there appears to be no single, universal design for the successful educational film, we do know something of the elements in the design and how they operate in the process of film communication.

It is not surprising, however, to find that not all of the films analyzed exhibit all of the possible and theoretically desirable elements which might be used in the film designed for education. Film making involves the judicious selection and use of various film techniques and rhetorical elements in view of the intended purpose and the intended audience rather than the mechanical application of a formula. Without such selectivity, it has been shown, the elements of a given film may conflict, producing inhibitory or negative effects which destroy its effectiveness as a communique.

With respect to the well-designed educational film, the following conclusions apply:

1. Its effect will be proportional to the degree to which it is based on the common interests and needs of the audience for which it is intended.
2. The vocabulary level of the audience should be kept clearly in mind in preparing film narration, but it must be recognized that what is said is seldom as important as what is shown on the screen.
3. The structure of the film should be simple enough to be understood by its intended audience. It should not contain too many different ideas, nor move too fast.
4. The rate at which the commentary is delivered should be between 100 and 130 words per minute.
5. The film may well include an introduction which clearly and succinctly poses the problem, orients the audience, and establishes "set," or a condition of readiness for the presentation.
6. Key ideas may be repeated two to four times for emphasis and reinforcement, but the repetitions should be varied and aesthetically satisfying as well. The summary is also useful as a form of repetition.
7. The running times of classroom films may vary from five to 30 minutes to fit the class period. Within this limit, the major consideration in film length will not be the capacity of a 16mm reel, but the nature of what is said and the best manner of saying it in motion picture form.
8. It should be recognized that the motion picture experience is an active, not a passive one, and that audience involvement in any type of film is a matter of degree. The elements of identification, familiarity, anticipation, participation, and dramatic structure will be built into the film to the degree necessary to bring about that changed behavior and sharing in common which marks successful communication and effective learning.
9. Color, music, sound, animation, optical, and special effects will be used selectively to simplify, amplify, and reinforce the main idea. The possible distractive influence of these factors will be studied. The subliminal

effects of these elements will also be recognized and further explored.

10. The educational film will be deliberately designed to promote the finding and testing of meanings. In such films there will be more "forked-road" situations, more use of "open endings," to make the film experience a means of promoting new and better ways of thinking and behaving.

The present popularity of certain films cannot, of course, be taken as the sole criterion for future production. As with books and other materials, there is a great need for films on a wide variety of topics, presented in a diversity of styles, ranging from the very expensive production of theatrical impact designed for large audience to the low-budget, simply-constructed film for the small, specific audience.

We must also learn to build good teaching techniques into films so that they communicate directly and effectively with or without further explanation. While good utilization by a capable teacher improves the chances of learning from film, there is a need for superior films in situations involving rapid, mass learning. This need may become increasingly acute in the coming years as our educational system is strained by a rapidly growing student population and a persistent shortage of good teachers at all levels. Such films may also be required in adult education and for educational television.

The need for a wide variety of "self-sufficient" films deliberately designed to influence behavior places a heavy responsibility upon the producer of the educational film. It is a job which requires a constant re-examination of film techniques, an unwillingness to rely on formulas, and a basic understanding of the process of communication. The designer of educational films must be technician, teacher, artist, and scientist. Last, but not least, he must clearly understand the importance of his role as communicator of ideas in the light of the educational goals of our democratic society.

Through the years, the design of the educational film will change with the changing curriculum, with the development of new motion picture techniques, with the wider range of subject matter dealt with by an increasing number and types of film producers, and with the inevitably changing needs and interests of the society in which the films are produced and shown.

Present research in perception, group dynamics, social psychology, and related fields may influence the teaching film of the future. New methods in animation are being developed; the production of films through television systems is being explored; and it is now possible to record images, sound, and color on magnetic tape. Psychologically, sociologically, and technologically, our knowledge of the processes and techniques of communication is being rapidly expanded. As a result, the educational film fifty years hence, whether electronic, three-dimensional, or wide screen, will be sharply different from the educational film as we know it today.

The study of how to make effective educational films is in its infancy. Much of what has been done is weakened by attempts to apply scientific methods and statistical procedures to processes which in themselves are little understood and not completely scientific. This has resulted in the accumulation of data which are contradictory, inconclusive, or meaningless.

Perhaps the great frontier for research in educational film production is in a deeper, more basic study of "signs"

and "symbols," of which the motion picture is composed. Such research would involve a study of the motion picture for what it really is -- a symbol system, not simply a method of reproducing reality. It would have as its ultimate objective the development of a more simplified, and perhaps a more economic design for the educational film, and one which would tend to increase the linearity or directness with which the communicatee passes from communicator to communicatee.

The motion picture does not achieve its effect simply by being "realistic." The choice of lenses, the selection of camera angle, the chemical and physical transformations which take place in the production of a photographic record constitute a screen or grid which effectively changes the appearance of things "as they really are."

On the other hand, the motion picture deliberately conceived and constructed as an audio-visual symbol system can be more "real" than real, can throw new light on the commonplace through a calculated reorganization of experience and reality. Pictures, words, and sounds would be selected and organized with respect to their importance as key signs or symbols at specific points in such a film, and with reference to the probable perceptive behavior of the intended audience.

This deeper study of audio-visual signs and symbols would concern the anthropologist, the psychologist, the sociologist, and the philosopher, as well as the teacher and the film maker, for it is a study of a fundamental human process. In the end, such a study must surely lead not only to a technique of film making, but to a philosophy of film making, to a philosophy of education, and to a way of finding and testing meanings in the symbolic world in which we live. Microfilm \$3.80; Xerox \$12.80. 294 pages.

1. "Report on Most Used Films," *EFLA Bulletin*, 9 (Feb., 1953), pp.2-3.

Abstract published by special arrangement with The Ohio State University.

**A STUDY OF THE RELATIONSHIPS BETWEEN
KNOWLEDGE OF CHILD GROWTH PRINCIPLES AND
THEIR APPLICATIONS IN MULTIPLE-GRADE
TEACHING IN CERTAIN COUNTIES IN NEBRASKA,
SOUTH DAKOTA, AND MICHIGAN**

(L. C. Card No. Mic 58-5315)

Lula R. Way, Ed.D.
Michigan State University, 1957

This is a study of relationships between what teachers know in principle and what they do in practice concerning child growth. The findings of the study are based upon: (1) a personal questionnaire used to determine the status of their training (2) a continuum type of reconstruction of their classroom techniques used to determine their application of child growth principles.

Random sampling of teacher's names were drawn from county rosters in twelve north east Nebraska counties, two south east South Dakota counties and two Michigan counties.

By mass tabulation a measure of how well or how poorly the child growth principles were being applied in the teaching of reading, arithmetic, social studies and natural science was obtained. By individual tabulations it was

possible to obtain a judgment of how well any one teacher was applying what she knew of child growth principles in any one or all four areas represented on the continuum. Thus the study had both cross-sectional and longitudinal aspects.

The major relationships indicated by the study were:

- (1) reading is being taught with little application of current child growth principles and with but little evidence of progression in method
- (2) there is more agreement of principle and practice with regard to arithmetic
- (3) natural science shows evidence of the impact of newer concepts of teaching methods and better application of current child growth principles
- (4) social science shows the greatest evidence of the application of current child growth principles and the use of good method
- (5) supervision on a county wide basis has not been a determinate factor in the application or the non-application of child growth principles
- (6) the correlation of the age of the teacher and her ability to teach was negative
- (7) the correlation of the teacher's recency of training and her ability to teach was negative
- (8) the correlation of the number of college hours held by the teacher and her ability to teach was negative
- (9) the correlation of the extent of help the teacher felt her college classes had given her and her ability to teach was positive and significantly so at the five percent level
- (10) the correlation of the years of teaching experience to the ability to teach was positive but only slightly so
- (11) if one were desirous of picking a good teacher in all four areas of teaching he need only to know how the teacher teaches arithmetic to know how effectively current child growth principles were carried out in other areas of the curriculum. Microfilm \$2.25; Xerox \$8.00. 172 pages.

**A COURSE OF STUDY IN GENERAL SCIENCE:
THE PREPARATION OF A COURSE OF STUDY
BASED UPON THE NEEDS OF STUDENTS TO WHICH
THE MAJOR OBJECTIVES OF SCIENCE
INSTRUCTION MAY CONTRIBUTE**

(L. C. Card No. Mic 58-5659)

Samuel Henry Wyatt, Ed.D.
New York University, 1958

Chairman: Professor Cyrus W. Barnes

Statement of the Problem

The purpose of this investigation was to produce a course of study in general science based upon the needs of students to which the major objectives of science may contribute. In order to construct the course of study, the following two sub-problems were investigated:

1. An investigation of the needs of junior high school students.
2. The determination of the major objectives of science instruction having application to the needs of junior high school students.

After the course of study was constructed it was evaluated by educators and professional people who had close contact with the students of this investigation.

The Educational Significance of the Investigation

Hardly a recent textbook or yearbook fails to mention the importance of meeting the needs of youth. In spite of these writings by educators, there has not been established a wide range of action toward helping youth to meet their needs. While this investigation does not purport to solve all problems related to needs, four aspects of this study are a step forward in this direction. First, an attempt has been made to relate the major objectives of science instruction to the needs of the students as a basis for the selection and organization of instructional materials. Second, the investigator attempted to take a step in the direction of solving the problem associated with the needs of youth which are related to science. Third, the investigation was done on the local level, thus eliminating some of the weaknesses involved in curriculum construction if the designers are far removed from the community. Finally, a methodology is provided by which a course of study in science based on the needs of students might be developed on the local school level.

Methods Used in Constructing the Course of Study

A. The needs of the students were determined by administering a revision of Doane's inventory to 712 boys and girls attending a selected junior high school and a group of 30 selected adults.

B. The relative importance of the major objectives of science instruction listed in the Forty-Sixth Yearbook in terms of their application to the needs of the student was also determined. A questionnaire containing the major objectives of science instruction and needs of the students was submitted to twelve educators in the fields of science and science education. The judgments of the educators represent the basis for formulating which major objectives of science instruction were most important, important, or unimportant in helping the students to meet their needs.

C. The selection of learning activities that appears under each major objective of science instruction was determined by an examination of textbooks, courses of study, film publications, journals, and other literature pertaining to the needs of youth.

The Course of Study

The course of study consists of the needs of the students. For each need of the students are listed the major objectives of science instruction. The relative importance of the major objectives of science instruction judged in terms of the needs of the students is indicated by the presence or absence of an asterisk. In order to attain the major objectives of science instruction for each need of the students, a learning activity or a group of learning activities is suggested.

After completion, the course of study was evaluated by a jury of ten members. The jurors felt that the course of study adequately met the criteria which were set up for the selection and the organization of content.

Microfilm \$9.60; Xerox \$34.20. 758 pages.

AN ANALYSIS OF GREEK-LETTER SOCIAL FRATERNITIES AS A FACTOR IN STUDENT LIFE AT THE OHIO STATE UNIVERSITY

(L. C. Card No. Mic 59-2332)

William Augustus Yardley, Ph.D.
The Ohio State University, 1953

The role of fraternities in the educational scheme or as a unit in democracy has been subject to controversy since the founding of Phi Beta Kappa in 1776. In large measure, speculation and opinion based upon the limited experiences of individuals have served as foundations upon which much of the fraternity controversy has been structured. The need for tangible evidence is apparent.

There are many facets to the fraternity question. The focus of the dissertation is upon what appear to be the three major issues involved: 1) whether or not fraternities are functioning on a democratically acceptable basis; 2) whether, and to what degree, fraternities contribute to or detract from the personal-social growth and development of individual members; and 3) whether or not fraternities, as organized groups, affect total campus life positively or negatively.

Purposes Of The Study

The intent of the study is to investigate the men's Greek letter social fraternities and the resultant fraternity system which is functioning at The Ohio State University and to analyze critically the system and member group operation with the purpose of testing the following hypotheses. 1) Fraternities are functioning on a democratically acceptable basis, as defined by the National Interfraternity Conference Principles of Democracy, and are, therefore, justifiable in contemporary United States democracy. 2) Fraternities are contributing to the personal-social growth and development of fraternity members. 3) Fraternities are making a valuable contributions to total campus life.

As a result of surveying studies of fraternities in American colleges and universities, the writer concluded that existing investigations either have attacked only certain aspects of the three issues cited previously or have not selected the operation of a system in totality. By selecting the system at The Ohio State University the writer aspired to minimize the latter criticism. A comprehensive approach is attempted by an examination of data relevant to the three major hypotheses of the study.

Testing The Hypotheses

In reference to the first hypothesis, it is apparent that the concept "democratically acceptable" must be clearly defined. For purposes of the dissertation, the Principles of Democracy described by the National Interfraternity Conference were used. Next the writer interpreted the principles in terms of criteria upon which the factors investigated were analyzed. The data which were used to determine how well fraternities met the criteria follow.

1. The nature of selective qualifications and the number of chapters employing them
2. A compilation of the opinions of college officers and fraternity leaders regarding discriminatory practices
3. Member evaluations of the amount of freedom their fraternity membership permits in doing, thinking, and speaking according to choice

4. A list of the nature and extent of national fraternity and local chapter controls compiled by chapter presidents
5. Policies regarding the dismissal of members
6. Initiation policies
7. Member evaluations of fraternity influence upon ten items related to personal-social growth
8. Policies regarding the frequency of changing officers, their qualifications, and selection
9. The amount of member participation in chapter program and activities
10. The opinions of sixteen University staff members regarding the status of fraternities in student life
11. Member evaluations of the emphasis their fraternity puts upon ideals, symbols, and rituals
12. Member evaluations of fraternity influence upon experiences related to democratic values
13. The status of subversive charges leveled against Greek organization as judged by the Dean of Men.

Data used to test the second hypothesis included:

1. Member evaluations of fraternity influence upon certain items related to personal-social growth
2. Freshmen self-evaluations regarding items of personal-social growth on a within-group change basis over a period of one school year
3. Influence of leadership positions upon chapter officers
4. Cases of voluntary drop-outs and dismissals
5. The opinions of chapter housemothers.

Data used to test the third hypothesis included the role of fraternities in: a) extra-curricular activities; b) student government; c) campus politics; d) major all-campus student projects; e) Student Union operation; f) religious activities; g) academic life; h) the three major men students' honoraries; i) disciplinary measures instigated by the University toward organization and individuals; j) certain negative types of student activity, and k) University orientation program.

Summary Of Conclusions

The first hypothesis stated that fraternities are functioning on a democratically acceptable basis, as defined by the National Interfraternity Conference Principles of Democracy, and are, therefore, justifiable in contemporary United States democracy. Analysis of the data relevant to each principle revealed the following.

Principle 1. (Fraternities) adhere steadfastly to social, religious, political, and economic democracy as the only sound basis for a satisfactory personal and national life.—The fraternity system does not adhere to the social and religious parts of Principle 1, but the political and economic parts are satisfactorily met. The general conclusion is that Principle 1 is not being completely adhered to since at least 73 per cent of all groups and probably more enforce some selective qualifications.

Principle 2. (Fraternities) defend the individual's right to liberty and equality of opportunity.—Fraternities are adhering to Principle 2.

1. Ninety-five per cent of the chapter members feel that they enjoy at least some freedom from control or arbitrary authority in their affiliation
2. National fraternity and local chapter controls do not appear to detract from individual rights
3. With four possible exceptions, all grounds for dismissal seem reasonable to the respondents and do not detract from individual rights

4. A majority of groups adhere to democratic processes in the voting part of member dismissal cases
5. With one exception, all members of the system grant hearings to a dismissed member if he desires to appeal his case
6. Ninety-one per cent of the fraternities in the system have banned paddles as an instrument of initiation, and, with two exceptions, the chapters recognize individual desires in case of appealing against initiation treatment
7. Ninety-four per cent of the chapters permit all members to present nominees for office; none of the officer selective qualifications seems to detract from equality of opportunity in fraternity units, and all chapters rotate positions of leadership at least yearly and adhere to majority rule in voting for officers.

Principle 3. (Fraternities) inculcate a sense of responsibility to self, to college, to country, and to society.—Fraternities are adhering reasonably well to those parts of Principle 3 concerned with responsibility to self, to college, and to society. There are insufficient data pertaining to responsibility to country to formulate a conclusion. The basis for the foregoing statements, with reservations included, follow.

1. Approximately 90 per cent of the fraternity members attend chapter meetings, while at formal initiations of forty-one groups report 90 per cent or more present
2. Nineteen groups report 90 per cent or less member participation in rush week
3. On the basis of the responses of chapter presidents, participation in chapter house dances and in the non-dance parts of chapter house social programs is judged to be excellent
4. On the basis of the responses of fraternity men, fraternities have not completely solved the problems evident in the area of member behavior while drinking
5. Eighty-six per cent of the affiliates felt that they have been positively influenced in matters of personal appearance
6. One-hundred per cent of the fraternities reported that they afford initiates full opportunity to attend classroom sessions during initiation week
7. Member evaluations indicate that Greek organization exert a definite positive influence on member participation in nonclassroom school life
8. Sixteen staff members felt that in general, the role of fraternities in most phases of campus life was positive
9. Member evaluations indicate that fraternities tend to exert a definite positive influence in accepting the views of others and in the matter of ability to act in a socially acceptable manner with girls
10. Member evaluations indicate that fraternities tend to exert a positive influence in members acceptance of people of different social and economic levels, in developing respect for the "other guy" in other social or racial groups, and in developing cooperativeness.

Principle 4. (Fraternities) stress the spiritual values of life as the foundation of the truly democracy way of living.—The fraternity system as a whole is not adhering to Principle 4. This conclusion is based upon the results

of a questionnaire in which only 49 per cent of the members felt that emphasis upon ideals, symbols, and rituals have been strong.

Principle 5. (Fraternities) support our country's championship of the cause of democracy.—Fraternities are adhering to Principle 5 since they seem to be providing experiences related to democratic values resulting in a positive influence, according to 77 per cent of the members, while only 3 per cent reported a negative influence.

Principle 6. (Fraternities) condemn all activities tending to subvert the principles and processes of democratic government; Principle 7. (Fraternities) pledge unqualified loyalty and devotion to country.—On the basis of the following limited evidence, the writer states tentatively that fraternities are adhering to Principle 6 and 7.

1. Records in the Dean of Men's Office reveal that no chapter within the fraternity system has even been charged with furthering movements and activities which detract from the government.
2. Theoretically, by accepting the National Interfraternity Conference Principles of Democracy, Greeks have assumed a loyalty and devotion to the democracy of their country.

The foregoing summary of conclusions indicates that the hypothesis cannot clearly be proved or disproved. Qualifications are of such a nature that neither conclusion is completely warranted. However, it seems to the writer that the data presented in the study supports the hypothesis for these reasons:

1. A majority of the principles have been at least reasonably well adhered to.
2. Discrimination, which is the fundamental issue in testing the hypothesis, is practiced regarding to race and religion, but not regarding political and economic status.

The second hypothesis stated that fraternities are contributing to the personal-social growth and development of fraternity members. The following two points do not support this.

1. Responses of fraternity members indicate that academic record and study habits, as a part of personal-social growth, are negatively influenced in a relatively large number of cases.
2. It is the writer's judgment that for some men who have withdrawn or been dismissed, fraternities detract from personal-social growth.

The data relevant to the hypothesis, largely supporting it, follows.

1. Fraternity influence upon the over all personal-social growth of members is judged by fraternity men to be largely positive. A substantial proportion of affiliates, or 23.9 percent, experience no influence regarding certain personal-social growth items. A negative influence is reported by 4.6 percent.
2. As judged by fraternity men, negative influence exerted on academic record and study habits is much greater than for any other item.
3. As revealed in the responses of presidents and treasurers, the influence of positions of fraternity leadership on selected items of personal-social growth is primarily either positive or is of no consequence.
4. In the writer's judgment, some cases of pledge dismissal or voluntary withdrawal have resulted in a negative affect upon individual personal-social growth.

5. A large majority of fraternity housemothers feel that affiliation results in a positive influence upon items related to members personal-social growth.

The third hypothesis stated that fraternities are making a valuable contribution to total campus life. The following four points do not support this.

1. The failure of fraternities to make a maximum positive contribution to academic life
2. Three violations of University general conduct rules
3. Participation in negative types of student life
4. Failure to be completely cooperative with the University orientation week program.

The data relevant to the hypothesis, largely supporting it, follows.

1. Based upon the reports of student organizational officers, the amount of Greek participation in extra-curricular affairs is judged to be particularly high.
2. From records of the number of Greeks holding student offices it was concluded that: a) campus political power was almost completely dominated by fraternity men during the school year 1952-53, and b) Greeks are more active and maintain the greatest percentage of leadership positions in major all-campus student projects than any other group of students.
3. As indicated by the number of fraternity men who participate, Student Senate members are predominately fraternity affiliates, while officerial posts are completely dominated by Greeks.
4. The report of Union Director Stecker indicated that except for one girl, fraternity men completely dominate positions of leadership in Student Union activities.
5. As reported by Intramural Director Staley, fraternities and their members are numerically the greatest participants in most sports in University intramurals.
6. In the opinion of Religious Coordinator McLean, Greeks are active in religious affairs, but probable less active than nonfraternity men.
7. In the writer's judgment, because of the lack of emphasis placed upon scholastic achievement by fraternities, the chapters are not maintaining a satisfactory status in academic life.
8. Fraternity men dominate the memberships of three major male honoraries according to membership lists.
9. Student Court records reveal that the position of fraternities and their affiliates in disciplinary action taken by the University is largely satisfactory.
10. According to the Orientation Week Committee report, fraternities seem to be detracting from certain phases of the University orientation week program.

Summary

Initially, three issues which appeared to be fundamental to the fraternity controversy were stated in the form of hypotheses. Data relevant to the hypotheses were then gathered from the fraternity system at The Ohio State University. The conclusions reached indicated that one hypothesis could not be adequately proved nor completely disproved, whereas the second and third hypotheses were proved with certain reservations.

Microfilm \$3.20; Xerox \$11.00. 248 pages.

Abstract published by special arrangement with The Ohio State University.

EDUCATION, ADMINISTRATION

THE COUNTY SUPERINTENDENCY IN NEBRASKA--
CURRENT STATUS AND POSSIBLE FUTURE

(L. C. Card No. Mic 59-1879)

Fred Woodrow Wilson Anderson, Ed.D.

The University of Nebraska Teachers College, 1959

Adviser: Merle Arden Stoneman, Ph.D.

The Problem

It was proposed in this study to review the development of the county superintendent and the corresponding intermediate unit in other selected states. It was hoped that studies of the development of these units and of the services performed by them would provide some indication of how such units in Nebraska might be developed and improved.

The Procedure

Two major methods were used to collect the desired information. First, available literature in the field was reviewed. Secondly, a survey was made of the intermediate units in several selected states, having different types of intermediate units, providing a wide geographic distribution, and representing areas of varying densities of population.

Findings

Various factors--reorganization, changing enrollments, contractual practices, changing educational demands and programs--have brought, and are continuing to bring, changes in the function and status of the intermediate unit office, in Nebraska as in other states.

Nebraska counties are far behind intermediate units in other states in types and quantity of service offered and in personnel available from or through the intermediate unit office.

Nebraska has little in state funds available to pay the costs of special services from the intermediate unit office. The amount of state aid seems to be directly proportional to the number of personnel and the amounts of special services available.

Conclusions

An intermediate unit should provide the following:

1. coordination and leadership of the activities of local districts within the intermediate area;
2. provision of such special education, advisory, and administrative services to local districts as can be furnished more economically and effectively in a manner consistent with local control of the educational program;
3. coordination of programs of shared services between local districts or between the intermediate district and local districts or between intermediate districts;
4. reporting services between the state and local districts, representing the state in maintaining standards and assisting the local district in the development of improved educational programs; and
5. a responsible policy-making intermediate board of education to appoint an intermediate unit superintendent

as its chief executive officer and to provide a suitable staff and adequate and proper financing to carry out the program of the district.

In the development of suitable intermediate units for Nebraska the following criteria seem appropriate:

1. The intermediate unit should have sufficient pupils so that required educational services can be provided economically either separately or in cooperation with other districts.
2. The intermediate unit should be sufficiently large and have the resources necessary to attract and to hold a high quality of educational leadership and to provide adequate consultant and advisory personnel in addition to supervisory and special instructional staff members.
3. The area should be sufficiently compact that citizens can be made to feel a keen sense of responsibility and need for the type of educational program provided and needed.
4. Factors of distance, topography, density of population, and social unity should be considered in order to establish or maintain economical efficiency and sociological unity.
5. Equality of educational opportunity requires, not only extensive intermediate units, but definite commitments from the state level for the support of approved educational programs.

The development of desirable intermediate units will depend upon the active support and study by both lay and professional groups and legislative authority to encourage the organization and development of suitable units and approved educational programs.

Microfilm \$5.80; Xerox \$20.40. 453 pages.

PRE-SERVICE TRAINING OF PROSPECTIVE
ELEMENTARY SCHOOL PRINCIPALS

(L. C. Card No. Mic 59-1838)

Arthur Edmund Banta, Ed.D.

University of Southern California, 1959

Chairman: Professor Emery Stoops

It was the purpose of this study to identify school districts in California with known programs of preservice training for prospective elementary school principals and to ascertain the objectives, practices, and distinctive features of these programs. To gain perspective on these California programs, they were to be compared and contrasted with similar programs conducted in the other states of the Union. The problem dealt with in the study was to determine the status of such preservice training programs and the status of trainees in these programs.

Data were obtained from a study of library sources, from personal interviews conducted in California school districts with known preservice training programs, and through a nation-wide questionnaire study.

Findings and Conclusions. There were no generally accepted practices relating to the teaching status of trainees, payment of trainees, financing of preservice training programs, objectives for programs, or evaluation of programs. The duration of training tended to be on a one-year basis. A variety of training methods were used within individual preservice training programs. Among the most

widely used training methods were apprenticeships, internships, group discussion, case studies, group dynamics, and observation of administrative and instructional practices. Executive development programs used by industry have utilized some training methods which have not yet been attempted by school districts conducting preservice training programs for their prospective elementary school principals. Among these methods are counseling, special reading assignments, and Junior Administrative Cabinets.

Recommendations. (1) The elementary principal preservice training program should be an integrated part of a total administrative training program for district administrators and supervisors. (2) A statement of objectives should be written out for the training program. (3) An institution of higher learning should be involved in the planning procedures after philosophy and objectives have been formulated by an administrative council and ratified by the lay board of education. (4) Evaluative procedures for the program should be proposed in terms of the objectives. (5) Training techniques should be formulated by the administrative council with the assistance of representatives from the university. (6) Training techniques should be geared to fulfill the requirements inherent in the stated objectives for the program. (7) A budget should be submitted, which will show all direct and all hidden costs of the training program. (8) A comprehensive testing program should be instituted to screen applicants for training. (9) Provision should be made for training in human relations. (10) Morale factors for the trainees should be considered. (11) Programs should be developed to correspond to stated duties of the elementary school principal and to recognized problems of new elementary school principals. (12) The program should be geared directly to a "manning" table which shows all administrative positions which could conceivably become available in the school district.

Microfilm \$3.25; Xerox \$11.00. 249 pages.

OPERATIONAL PATTERNS IN PUBLIC SCHOOL ADMINISTRATIVE ORGANIZATION: A FUNCTIONAL ANALYSIS

(L. C. Card No. Mic 59-2477)

Claude Birkhead Boren, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Harry Estill Moore

This study is a sociological analysis of selected practices and structural characteristics within public school administrative organizations. The administrative patterns and practices of concern here were found originally in the professional literature of educational administration where they were presented as being characteristic of the more recent developments in that field - developments which were then observable in some school systems but which were presumed to be of much wider applicability in the immediate future. They were considered to be indications of the general characteristics of educational administration in the future. The change which was occurring was from an "authoritarian" to a more "democratic" or "co-operative" structure and practice for planning and directing the operation of the public school. The specific admin-

istrative patterns and practices involved were: the use of advisory committees of laymen for educational planning, the use of general and special-purpose advisory and planning committees with membership drawn from the school staff and faculty, the creation and use of more direct and two-way channels of communication within the organization and extending into the community, and a changed status and role of the educational supervisor from a "line" to a "staff" relationship with teachers.

These suggested emerging administrative practices, stated as hypotheses, were investigated with respect to their conformity with the observed characteristics of the administrative organization and operation of nine public school systems in Texas. However, the research was undertaken not so much to test the hypotheses as to reveal the conditions and consequences which accompanied the stated practices in the different school systems. In this historical and functional analysis an attempt was made to determine the way in which each administrative practice affected the school as an organization in the community and in society. To that end data was secured and analyzed in accord with two sociological conceptual and theoretical schemes. First, the public school administrative organization was conceived and defined as a "formal organization," following the theory of formal organization developed by Chester I. Barnard and presented by him as being universally applicable for the study of such collective enterprises. According to this theory a formal organization would be a cooperative system comprised of the activities of two or more persons, a system of activities which required for its creation and continued existence a common purpose of cooperation, communication among the persons involved in the cooperation, and willingness on the part of the persons involved to make the necessary contributions. In terms of a second sociological theoretical orientation, "structural-functional analysis," the various administrative patterns and practices were related to the maintenance of the administrative organization as a whole by their influence upon one or more of the three elements of organization - common purpose, willingness, and communication.

The school systems studied were participants in the Cooperating Centers Project of the Southwestern Cooperative Program in Educational Administration, an action research project of five years duration sponsored by the Kellogg Foundation and having regional offices at the University of Texas. Project records - recorded interviews, reports of observers and participants, and letters and documents - constituted the major source of data for testing and analyzing the hypotheses. However, this data was supplemented by personal interviews with the superintendent of each school system involved.

The data for the nine school systems studied tended to confirm the several research hypotheses. However, the formality with which a given practice was implemented was related to the over-all size of the school system, with the formal procedures for securing lay and staff participation in administration and for providing direct and two-way channels of communication among the participants being much more pronounced in the larger school systems. The functions performed for the administrative organization of the schools by the various patterns and practices studied did not vary with the size of the school system, however.

The use of lay advisory committees was deemed functional primarily in terms of the consequences for the willingness of laymen to support the school and its program,

although it was recognized, also, that the committees were functional as channels of communication between school and community and as influences in the development of school purposes. Staff committees were deemed functional primarily in terms of their activities in planning common purposes for the school systems although, as before, functional consequences in terms of the other two elements of organization also were envisioned. The direct and two-way channels of communication were considered functional for development and attainment of organizational purposes and for securing, through persuasion and the offering of incentives, the willingness of participants to make the necessary contributions to the organization. The changed approach to supervision of teachers was considered functional for teacher morale, i.e., in terms of "willingness" and for the development of purpose, at least at the level of the classroom.

Conditions and processes, both within the school system and in the surrounding society, were related to the various administrative patterns and practices and to the relative stress upon the function or functions attributed to them. In the community and society, the increased tempo of social change and the expanding population presented problems to the school, problems which, if they were to be resolved, required the cooperation and support of all "members" of the organization. Within the school there had been progressive specialization and professionalization of both administrators and teachers with the result that teachers were not only increasingly capable - due to their extended period of educational preparation - of planning and directing their own contributions to the organization, but they were possessed of knowledge and experience pertinent to the overall operation of the school system and not equally possessed by the educational administrator. Independent of the pragmatic or "functional" explanation for these emerging administrative practices, but equally a factor in explaining their occurrence, was the emphasis placed upon "democracy" as a basic value in our culture, and the fact that these practices consistently were defined as being in accord with that value.

Microfilm \$9.00; Xerox \$32.00. 710 pages.

**A SURVEY OF PRACTICES AND REGULATIONS
PERTAINING TO FRINGE BENEFITS FOR
PROFESSIONAL EMPLOYEES IN SELECTED SCHOOL
DISTRICTS IN PENNSYLVANIA**

(L. C. Card No. Mic 59-2392)

Samuel Cirola, Ed.D.
University of Pittsburgh, 1959

The purpose of this study was to identify and analyze the practices and regulations pertaining to fringe benefits for professional employees in selected school districts in Pennsylvania, and to ascertain the relationships between certain characteristics of the school districts such as class of district, type of community, number of professional employees, percentage of male professional employees, state standard reimbursement fraction, professional employee turnover, basic salary schedule, and the type of fringe benefit plans adopted by the districts.

The normative-survey method of research by means of

a questionnaire was employed in this study. The factual information gathered by the questionnaire and the subjective comments noted by the chief school administrators were used as the body of the study.

Some of the principal findings as a result of this study are as follows:

1. Eighty-eight per cent of the reporting district in this study had sick leave plans in 1956-1957 with provisions which surpassed the state mandated plan.

2. The most liberal sick leave plans were found to be in operation in the smaller industrial and residential cities. However, the larger school districts comprised the greatest percentage of districts with sick leave plans more liberal than the state mandated plan.

3. Approximately one-fifth of the reporting school districts permitted staff members to use cumulative sick leave allowances in cases of absence caused by family emergencies, while more than one-third of the districts decided the question of absence with pay due to family emergencies on a merit basis.

4. Approved absences with pay of a personal nature which showed somewhat significant percentages were religious holidays and attending the funeral of a friend. These fringe benefits were granted mainly by industrial districts with low state reimbursement fractions.

5. Most school districts approved absence with pay for attendance at professional meetings and conventions. Eighty-three per cent of the school districts had policies and provisions for payment of staff members' expenses incurred when attending such meetings. The larger residential school districts with the lower state reimbursement fractions, and the over-state mandated salary schedules were the leaders in granting these fringe benefits.

6. There were fewer requests for sabbatical leaves of absence in 1957-1958 than in 1956-1957.

7. While group hospitalization was available in more school districts than any other type of group insurance, only 26 per cent of the school districts made contributory payments toward the premium costs of this insurance.

8. The third class industrial districts with the low state reimbursement fractions were the most liberal in granting the fringe benefit involving reimbursement of graduate study tuition.

The conclusions drawn as a result of this study indicate that school boards are becoming more liberal in granting sick leave over and above the state mandated plans. Characteristics of certain school districts show a significant relationship to the quality of the sick leave program. These include population size, basic salary schedule, reimbursement fraction, and number of professional employees. School boards are showing more sympathy from a financial standpoint toward payment for absence due to family emergencies. The percentage of male employees and professional employee turnover appears to bear no relationship to fringe benefit provisions and policies of school districts. Wealth of a school district is an important factor in the awarding of fringe benefits authorized through permissive legislation. Contributory group insurance plans for professional employees are found to be in effect on a rather limited basis, and appear to bear no relationship to any of the school district characteristics employed in this study. Greater strides have been made in the granting of fringe benefits under permissive authority during the past seven years than during the previous two decades.

Microfilm \$4.90; Xerox \$16.40. 381 pages.

THE DEVELOPMENT OF PUBLIC JUNIOR COLLEGE FINANCING IN TEXAS

(L. C. Card No. Mic 59-2501)

Billy Claudius Daley, Ed.D.
The University of Texas, 1959

Supervisor: Professor J. W. Reynolds

PURPOSE OF STUDY: The purpose of this investigation was to find answers to the questions: What are the sources of the operating income for the public junior colleges of Texas, and how did this procedure of financing develop?

METHOD OF RESEARCH: The data of this study were taken from three sources, (1) a review of the literature, (2) records in the Texas Education Agency and (3) a short questionnaire was sent to the public junior colleges of Texas established before 1947.

SUMMARY: The data of this study indicate that public junior college financing in Texas has gone through two developmental stages and that it is now in the third. The period from 1920-1929 might appropriately be called the experimental stage. The first local public junior colleges of Texas gave free tuition to resident students and were financed from local funds. This procedure soon met opposition. Tuition and fees were the results of this development and until the present have accounted for a major portion of the operating income of these institutions. During this period the junior colleges of Texas were without legal authority.

The second period in public junior college financing in Texas began in 1929 when the first junior college statutes were enacted. The total operating income during the period from 1929-1941 was received from two sources: tuition and fees and local funds. Income from tuition and fees accounted for a little over one-half and local funds a little less than one-half.

The third period in public junior college financing in Texas began in 1941 with the introduction of state aid. Income from tuition and fees accounted for 45. per cent, local funds 28.02 per cent, and state aid 26.27 per cent of the total operating income in 1941-42. State aid accounted for 18.77 per cent in 1944-45, 18.96 per cent in 1947-48, and since then it has shown an increase. The composition of the total operating income from 1944-45 to the present has remained relatively constant and it has been as follows: tuition and fees 30.95 per cent, local operating income 45.85 per cent, and state aid 23.10 per cent.

CONCLUSIONS:

1. The composition of the total operating income of the public junior colleges of Texas is relatively flexible and the data of this study indicate that it will remain flexible with considerable variation from institution to institution.

2. The data of this study indicate that income from tuition and fees will probably account for a smaller per cent of the total operating income in the future.

3. The income from the state appropriation will probably account for a larger per cent of the total operating income in the future.

4. It is indicated by the data of this study that local funds will probably account for a smaller per cent of the total operating income in the future.

Microfilm \$2.25; Xerox \$8.00. 172 pages.

A RATIO STUDY OF NON-INSTRUCTIONAL PROFESSIONAL PERSONNEL IN SELECTED PUBLIC SCHOOLS OF PENNSYLVANIA

(L. C. Card No. Mic 59-2394)

Stanley Richard Duda, Ed.D.
University of Pittsburgh, 1959

The purpose of this study is to derive desirable ratios between certain selected noninstructional professional public school personnel and the recipients of the services rendered by such personnel. These ratios are intended to serve as reasonable staffing guidelines in terms of numerical adequacy so that quality staff service may be expected.

The study included the following personnel classifications: Assistant Superintendents, Principals, Art Specialists, Music Specialists, Health and Physical Education Specialists, Reading Specialists, Librarians, Nurses, Physicians, Dental Hygienists, Psychologists, Speech Correctionists, and Home and School Visitors.

There were a total of 100 second- and third-class Pennsylvania school districts, under the supervision of a district superintendent, which provided data pertinent to the study. Actually, all second- and third-class districts having a district superintendent were invited to participate in the study. There were 184 such districts. A favorable response was received from 109 districts. No response was received from 52, and 23 were unwilling to participate for various reasons. Of the 109 willing participants, five failed to respond when survey packets were sent to them and four others returned information that was wholly inadequate. An aggregate total of 799 usable responses to the survey were received from personnel in the field. This was in addition to the responses of the 100 Pennsylvania district superintendents.

It should be noted that some school districts did not employ such personnel as was being studied. In many instances a comparable personnel classification was reported.

The study was organized on a tri-dimensional basis. First, suggested staffing ratios were gleaned from responsible authoritative sources in the literature. Second, current status ratios and an expression of desired service load adjustments were obtained from practitioners in the field via the aforementioned survey, in the form of a questionnaire. Third, guideline ratios for staffing purposes are a reflection of the writer's conclusions based on both the findings in the literature and the respondent's reactions to the survey.

After a careful analysis of the data, certain significant factors are manifest. The diversity of titles designating staff specialists, suggests a definite lack of understanding of the functions to be performed by specific personnel. The terms director, supervisor, consultant, resource person, and helping teacher are often misused. A clarification of titular roles ascribed to specialized personnel, in terms of a specific definition of the title in relation to precise connotations for the scope of the titular functions, is most desirable.

No ubiquitous plan of staff organization could possibly suit every school system. No single empirical staffing pattern can be devised for universal recommendation. However, staffing guidelines in terms of ratios for the purpose of determining numerical adequacy may be reasonably used as a point of departure.

This purpose may be implemented by providing personnel

in ratios of one Assistant Superintendent per 100 teachers, more or less; one Principal for each school of six or more teachers; one Art Specialist per 30 teachers or less; one Music Specialist per 40 teachers or less; one Physical Education Specialist per 50 teachers or less; one Reading Specialist per 40 teachers or less; one Librarian per 500 students; one Nurse per 1000 students or less; case load for one part-time Physician — 2200 students or less; case load for one Dental Hygienist — 1700 students or less; case load for one Psychologist — 250 students or less; case load for one Speech Correctionist — 75-85 students; and one Home and School Visitor per 3400 students or less. Microfilm \$2.15; Xerox \$7.60. 161 pages.

THE RELATIONSHIP OF CERTAIN CULTURAL FACTORS TO INITIATIVE IN THE LOCAL SUPPORT OF EDUCATION IN FLORIDA

(L. C. Card No. Mic 59-1724)

Gilbert Lee Gentry, Ed.D.
The University of Florida, 1959

Statement of the Problem

Local financial initiative for the support of schools exists in varying degrees among the several school districts in Florida. It is important for those interested in education to know what makes people willing to support education. This study was made to develop a broader understanding of the relationship between initiative in local support of education and certain cultural factors. The formal statement of the problem was: the relationship of certain cultural factors to initiative in the local support of education in Florida.

Procedure

Quantitative measures of financial ability and local tax effort beyond the statutory required minimum for participation in the state foundation program were correlated with factors representing certain aspects of the social climate.

Local financial ability was defined as the amount of taxable property per weighted measure of pupil load in a school district. The measure of ability was defined as the equalized assessed valuation of taxable property per unit of educational load in a school district.

Local tax initiative was defined as that tax effort beyond the minimum required by law for participation in the state foundation program. The measure of local initiative was the ratio of local school tax revenue beyond the statutory required minimum for participation in the state foundation program to an equalized assessed valuation of taxable property.

Social climate was defined in terms of certain cultural factors that were related to local initiative. The measure of social climate was a composite of median years of school completed by persons 25 years of age and over and the per cent population change from 1951 to 1956.

Results

Social climate had a correlation of .641 with local ability. Social climate has a correlation of .578 with local initiative. Local initiative had a correlation of .562 with local ability. The pattern of distribution of cases in the

several correlations indicated that linearity existed between the paired measures. Each correlation had a limited number of atypical cases.

Conclusions

The data in this dissertation indicate that the following relationships appear to exist in Florida:

Local financial initiative exists in varying degrees among the several school districts in Florida.

Local financial initiative is associated with local financial ability.

The aspects of the social climate tested were found to be closely associated with the willingness of the people to tax themselves beyond the required tax effort for participation in the state foundation program.

The following factors appear to account for some of the variation found between ability and initiative: (1) the state foundation program, (2) the tax structure, and (3) the effectiveness of lay and professional leadership.

The evidence seems to indicate that initiative has a two-fold effect: (1) the monetary effect, and (2) the operational effect. The monetary result of initiative is related to the level of ability. The operational effect of local initiative involves interest, experimentation, and efficiency in operation of local schools. The value of initiative at low levels of ability would seem to reside in the operational effect.

It is possible that the level of the state foundation program should be raised. The raising of the level of the state foundation program in the long run could raise the level of social climate. If the level of the state foundation program is raised serious consideration should be given to the matter of retaining some tax leeway for local initiative at all levels of ability. Local initiative could then increase as social climate increases.

Microfilm \$2.60; Xerox \$9.00. 197 pages.

EXTENDING THE PRESENT EDUCATIONAL PROGRAM IN THE LITTLE KANAWHA REGIONAL AREA OF THE STATE OF WEST VIRGINIA TO MEET THE FURTHER NEEDS OF THE YOUTH AND ADULTS

(L. C. Card No. Mic 59-2284)

Ronald Eisen Good, Ph.D.
The Ohio State University, 1953

The Little Kanawha Regional Area is located in the west-central part of West Virginia. The Little Kanawha River drains a major portion of the area, joining the Ohio River at Parkersburg. The Ohio River forms its western boundary. It is composed of the counties of Calhoun, Jackson, Pleasants, Ritchie, Roane, Tyler, Wirt, and Wood. It has an area of 2,700.65 square miles which is 11.1 per cent of the area of the state. The major portion of the area is within a radius of fifty miles of Parkersburg. The area can be classified largely as an agricultural region, Wood County being an exception to this general statement. In 1951 the assessed valuation of all property was \$226,107,950. The population of the area in 1950 was 145,064.

The study concerns itself with the development of a series of recommendations for a community-college program in the area. This necessitated three steps:

1. To determine from the area's twelfth grade students and from adults their needs as they see them for further education;

2. To develop a set of criteria for a community-college program in the area; and

3. To make recommendations for an area-wide community college educational program.

To determine from the area's youth and adult population their needs as they saw them for further education, questionnaires were prepared for the 1,324 high school seniors in the school year 1952-1953 in the seventeen high schools, for the parents of the seniors, for a select group of 176 farmers, and for the 8 county superintendents of schools and the 17 high school principals. Altogether 2,849 questionnaires were distributed and 1,465, or 51.4 per cent, were returned. Replies were received from 853 seniors; 494 parents of the seniors; 93 farmers; 8 county superintendents of schools; and 17 high school principals. Literature setting forth the basic principles accepted by authorities in the community-college field and the needs of the region under study were examined for the purpose of formulating a set of criteria for the establishment and operation of a community-college program in the Area.

Chapter I of the dissertation includes the limitations of the study and a clarification of a number of terms that are used in the study. Reviews of various related studies are included. The sources of the data and the methods used are presented, with the responses from the four groups who answered the questionnaires. Chapter II presents general criteria for community colleges and a set of criteria for a community-college program in the area. Chapter III describes the locale of the study in terms of its location, history of the present organization, size and topography, transportation facilities, population, assessed valuation of property, economic activities, and educational status. Chapter IV reveals the opinions of the high-school seniors concerning their educational and occupational plans, their interest and purpose in attending a community college, and their interest in the location of this type of school. Chapter V treats the fathers' and mothers' joint interest in youth education, the fathers' and mothers' separate interest in adult education, and the fathers' and mothers' joint interest in youth and adult education in a community college. The parents' attitudes toward extending the high school upward to include grades thirteen and fourteen, the location, and the financing of a community college are presented. Chapter VI presents the opinions of the farmers regarding their interest in extending and improving youth and adult education, attending a community college, the courses that should be offered, the time and place for bringing the needed courses to them, and their interest in teaching in a community college. Chapter VII treats the need for a community-college program as seen by the school administrators. Chapter VIII presents a summary of the findings of the study and some recommendations for a region-wide community college educational program.

The Opinions of the Seniors. The replies of the seniors to the questionnaires indicated that 37.7 per cent planned to attend college; 35.1 per cent had other plans; and 17.2 per cent were uncertain about future plans.

The replies of the seniors showed that 78.4 per cent were interested in the establishment of a community college.

It was estimated that the total regular thirteenth and fourteenth grade community-college student potential population in the area in 1965 will be approximately 2,000.

The following data show the response of the seniors concerning the distance they would travel to attend a community college: 18.9 per cent would attend within ten miles of home; 13.2 per cent would attend between ten and twenty miles away; 12.9 per cent would attend between twenty and thirty miles away; 28.8 per cent would attend between thirty and fifty miles away; and 26.2 per cent did not reply.

More than 50 per cent of the seniors indicated they would attend the community college if it charged not more than one hundred dollars tuition per year.

The opinions of the seniors relative to the location of the community college were: 41.1 per cent favored Parkersburg; 17 per cent favored one in each county; 32.5 per cent favored a community college serving from one to three counties; and 9.4 per cent did not reply.

The seniors gave the following indication of their purposes in attending a community college: 13.6 per cent would attend to continue their general education; 21.1 per cent would attend in order to take two years of regular college work; 49.6 per cent would attend to prepare for an occupation requiring not more than two years training beyond high school; and 15.7 did not reply.

The Opinions of the Parents of the Seniors. More than 47 per cent of the parents who replied to the questionnaires planned for the seniors to attend college.

Slightly more than 20 per cent of the parents were interested in taking community-college courses.

The present adult community college student potential population in the area is approximately 16,000.

The response of the parents concerning the distance they would be willing to travel to attend a community college is as follows: 13.1 per cent would attend within ten miles of home; 5.6 per cent would attend between ten and twenty miles away; 1.9 per cent would attend between twenty and thirty miles away; 2.4 per cent would attend between thirty and fifty miles away; and 77 per cent did not reply.

Approximately 70 per cent of the parents indicated there was a need for a community-college program in the area.

More than 54 per cent of the parents favored the establishment of a community-college program in the area.

Almost 30 per cent of the parents favored financing the community college by taxation; slightly more than 10 per cent favored tuition; over 20 per cent favored a combination of taxation and tuition; and almost 40 per cent did not reply.

Almost 61 per cent of the parents believed sufficient money can be provided to support a community-college program.

The opinions of the parents relative to the location of the community college were: 37.4 per cent favored Parkersburg; 18.9 per cent favored one in each county; 25.3 per cent favored a community college serving from one to three counties; and 18.4 per cent did not reply.

The Opinions of the Farmers. More than 87 per cent of the farmers who replied to the questionnaires favored the establishment of a community-college program in the Area.

Almost 23 per cent of the farmers were interested in taking community college courses.

The response of the farmers concerning the distance they would travel to attend a community college is as follows: 18.3 per cent would attend within ten miles of home;

23.6 per cent would attend between ten and twenty miles away; 14 per cent would attend between twenty and thirty miles away; 4.3 per cent would attend between thirty and fifty miles away; and 39.8 per cent did not reply.

The farmers favored evening courses in the local community. Their second choice favored day courses in the local community.

Winter was the first and autumn the second choice of the farmers of the season of the year to bring the needed courses to them.

Almost 50 per cent of the farmers favored financing the community college by taxation; 14 per cent favored tuition; 29 per cent favored a combination of taxation and tuition; and almost 9 per cent did not reply.

Almost 81 per cent of the farmers believed sufficient money can be provided to support a community-college program.

The opinions of the farmers relative to the location of the community college were: 36.7 per cent favored Parkersburg; 24.7 per cent favored one in each county; 37.6 per cent favored a community college serving from one to three counties; and 1 per cent did not reply.

Almost 83 per cent of the farmers were of the opinion that there was a need for a community-college program in the area.

The Opinions of School Administrators. According to the estimates of the administrators, an average of 20 per cent of all the high school graduates in the area attend college and an average of 48 per cent are judged capable of attending.

"Finance" was given by 92 per cent of the administrators as the main reason indicated by their seniors for not attending college, while only 76 per cent of the administrators themselves felt this was the case.

Eighty-four per cent of the administrators indicated that a community-college program would increase college attendance. Seventy-two per cent felt such a program would increase public-school attendance. Seventy-six per cent of the administrators felt there is a need for a region-wide system of community colleges.

"The need for educational opportunity" was the greatest factor favoring the establishment of a community-college program in the area indicated by the administrators.

"Finance" was given by 64 per cent of the administrators as the greatest obstacle in the way of establishing a community-college program in the Area.

Forty-eight per cent of the administrators said there was evidence that the eight counties in the Area would cooperate in establishing a community-college program and that the people in their county were favorable toward a community-college program.

Seventy-six per cent of the administrators favored locating one pilot school at a carefully chosen point while 12 per cent favored a school serving from one to three counties. Twelve per cent did not reply.

RECOMMENDATIONS

Recommendations for the establishment and operation of a community-college program in the area seem to fall into six major groups.

Legislation Needed

1. The necessary legislation which will permit the establishment and operation of community colleges should

be enacted in West Virginia. Provision should be made in such legislation for a single county or a combination of counties to form a community-college district, with a local board of education and executive officer under the general supervision of the State Board of Education and the State Department of Education.

2. The community college can best meet the needs of the people by remaining a two-year institution. State law should prohibit its becoming a four-year school.

3. The proposal for a community college should receive the approval of a majority of the voters in a non-political, special election held within the proposed community-college district. Final approval must be made by the State Department of Education.

4. Community-college students should be given free transportation to and from school in facilities similar to those now provided students in grades one through twelve.

5. The administrative, teaching, clerical, and custodial staff should enjoy all the privileges guaranteed by the state in regard to salary, tenure, retirement, and pensions.

6. The minimum enrollment should be 200 full-time students in the community college. The enrollment in grades nine through twelve in the community-college district should be approximately 600 as a minimum before a community college is established.

7. Should a student find it impossible to pursue the course of study of his choice in the community college nearest his home, provision should be made for his admission to a college elsewhere in the state under the same conditions he would be required to meet if that course of study were given at a school nearer his home.

8. In order to establish a community college the proposed community-college district should have a minimum assessed valuation of \$20 million.

9. This division of the public-school program should ultimately be tuition free.

Preliminary Steps

1. The people within the area should provide the initiative for the establishment and operation of the community college.

2. Preliminary area-wide and local surveys should be made to determine the need for and the ability to support the community colleges before these institutions are established.

3. Before a local community college is established a careful study of the plans and procedures used by such states as California, New York, Texas, Mississippi, and Missouri for the establishment and operation of junior or community colleges should be made.

4. The services of eminently qualified consultants in community college educational work should be secured to give advice in all the planning and procedure.

The Character of the Schools That Should Be Established

1. The organization of the thirteenth and fourteenth years should be integrated as closely as possible with the existing schools. The exact form of that organization will depend on a number of factors including all the factors involved in the existing situation.

2. The community college should provide a two-year program of college work that will include such general, preparatory, terminal, and adult educational curricula as will meet the needs of the people.

3. Adequate grounds, buildings, and equipment should

be provided to care for the instructional, recreational, and health needs of the students. Careful consideration should be given to the possible future growth of the school in all school-plant planning.

4. The community college should fully meet or exceed the standards set by all recognized accrediting agencies for such an institution.

5. An extension program should be organized that will take care of the educational needs and interests of students who find it impossible to attend classes on the campus. Both day and evening courses should be provided.

6. An effective guidance and placement service under the direct supervision of the administrative head of the community college should be established in the community college.

The Administration of the Proposed Schools

1. The State Level

a. The community college should be under the general supervision of the State Board of Education and the State Department of Education.

b. The State Department of Education should approve such courses given by the community college as meet its standards. These approved courses are to be accepted for credit in all the colleges and universities operated by the state.

2. The Local Level

a. The total secondary-school program of education through the thirteenth and fourteenth years should be placed under the direct supervision and direction of the administrative head of the secondary school with such assistants as are deemed necessary to provide an efficient administration.

b. A well-qualified administrative, teaching, clerical, and custodial staff should be secured.

c. The community college should have a lay-advisory committee that is broadly representative of the community-college district activities. This committee should acquaint the people of the community with the community college and advise the community college on future courses of action.

d. The pattern of control and supervision should be the same as for other phases of secondary education.

Finance

1. The community college should be financed by taxation and a moderately small tuition. As soon as the community can afford it, the program should be free.

2. The community college should be financed by local revenue, supplemented by state funds.

3. The state should provide equalization funds to guarantee a minimum program in the poorer districts.

4. Wealthy districts should be encouraged to support their community-college programs in a large measure.

Locations of Proposed Schools and Their Districts

Stage I. In order to get the community-college program started the eight counties of the area will comprise one community-college district. The community college is to be located at Parkersburg, Wood County.

Stage II. This is the final stage in the process of community-college development in the Area. Whenever conditions permit, the area is to be divided into three community-

college districts. The counties included in these districts and the location of the community college in each district are:

District 1. Pleasants, Ritchie, and Tyler Counties. The community college is to be located at St. Marys, Pleasants County.

District 2. Jackson, Wirt, and Wood Counties. The community college is to be located at Parkersburg, Wood County.

District 3. Calhoun and Roane Counties. The community college is to be located at Spencer, Roane County.

Microfilm \$4.80; Xerox \$16.00. 374 pages.

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THE IN-SERVICE TRAINING OF CLASSIFIED EMPLOYEES IN ELEMENTARY SCHOOLS IN SOUTHERN CALIFORNIA

(L. C. Card No. Mic 59-1991)

Taylor Thurman Jackman, Ed.D.
University of Southern California, 1959

Chairman: Professor E. H. LaFranchi

The major aims of this study were to determine (1) the effectiveness of selected in-service training activities for school district classified employees, (2) the activities which, in the judgments of classified and administrative personnel, should be included in an effective in-service training program, and (3) the areas in which selected in-service training activities were most effective.

It was also the purpose to ascertain (1) the most helpful in-service training activities being used in selected schools, (2) additional training activities which have been found to be effective, and (3) recommendations for the improvement of in-service training programs.

A normative survey method was employed in obtaining data for the study. Two separate questionnaires supplemented by interviews were used. The questionnaires embodied both a check-list appraisal of in-service training activities and narrative replies to questions.

The study included only elementary schools in Southern California whose districts were listed by county superintendents as those which were conducting good in-service training programs for classified employees. Fifty-three districts, or 93 per cent of those asked to participate, indicated willingness to participate. Questionnaires were distributed to principals, clerical employees, and custodians in 240 elementary schools. Altogether, 960 questionnaires were mailed: 480 to custodians and 240 each to principals and clerical employees. Of this number, 780 usable questionnaires, or 82 per cent of the total distribution, were returned.

Findings. All respondent groups (custodians, clerical employees, and principals) ranked very high the following in-service training activities: (1) dissemination of rules and regulations pertaining to classified employees, (2) opportunity to work with experienced personnel during probationary period, (3) opportunity to hold individual conferences with the principal or supervisor, (4) special job

instruction for new employees, and (5) meetings stressing job skills or problems of classified employees. All respondent groups preferred the following types of instruction: (1) meetings featuring the use of demonstrations and (2) combination-type meetings using demonstrations, films, and conference techniques. Respondents believed that in-service training meetings designed to improve job performance should be held on school time, and those designed for employee self-improvement or job advancement should be held on the employee's time.

Conclusions. (1) In general, the surveyed in-service training programs for classified employees were well planned and effective. (2) A lack of regularity in the scheduling of in-service training meetings and an infrequency of meetings were noted; both would indicate a need for thoughtful planning of programs. (3) Although respondents agreed concerning the value of most in-service training activities, some differences of opinion were so marked as to indicate a need for serious consideration by those in charge of training programs. (4) Classified employees are well able to evaluate their own training needs.

Recommendations. (1) Administrators in charge of in-service training programs for classified employees should gear training activities to the purposes to be served, and strengthen and broaden the scope of existing programs. (2) Administrators should omit use of the types of in-service training activities which classified employees believe to be of little value. (3) An evaluation check list for classified employees similar to that used in this study should be devised for use in training programs. (4) Individual conferences between classified employees and administrators should be developed as essential training devices. (5) Training meetings designed for job improvement should be held on school time; those designed for employee self-improvement and job advancement, on employee time. (6) Classified employees should be given performance evaluations and the opportunity to discuss ratings with the raters. (7) Administrators should make maximum use of the workshop type of training meetings using demonstrations, speakers, films, and question-and-answer conference techniques. Microfilm \$6.75; Xerox \$23.20. 530 pages.

CHARACTERISTICS OF THE PRE-SCHOOL CONFERENCE IN SELECTED PUBLIC SCHOOL SYSTEMS IN THE UNITED STATES

(L. C. Card No. Mic 59-2074)

Oliver Daniel Johns, Ed.D.
The University of Oklahoma, 1959

Major Professor: Dr. Donald Ross Pugmire

The extension of the school year to include 10 or more months in many of the 48 states has made it possible for public school systems to include time needed for in-service education programs in the regular calendar. Increasing numbers of systems are using a portion of this added time to conduct pre-school conferences. Such conferences afford opportunities for administrators to exercise professional leadership in the area of instruction and for teachers to experience professional growth through working together cooperatively on their problems.

The problem was to discover the characteristics of the pre-school conference in selected public school systems in the United States.

Data were obtained from 177 questionnaires, letters, and miscellaneous printed and duplicated materials which were received in response to requests sent to 205 selected school systems throughout the nation. Questionnaire responses were tabulated and other data were analyzed so as to reveal the characteristics of the pre-school conference in the 177 cooperating school systems.

Summary of the Findings

More than 90 per cent of the cooperating school systems reported that their pre-school conference programs were initiated within the last 15 years. Ninety-two per cent reported that the superintendent and/or other administrative personnel were largely instrumental in initiating the program.

Major purposes of the pre-school conference in order of importance as reported by respondents are: (1) to improve the instructional program, (2) to achieve a smoother and more efficient opening of the school year, (3) to improve the orientation of new teachers, (4) to initiate, stimulate, and improve the cooperative study of school problems, (5) to promote acquaintance among the faculty, and (6) to promote better understanding between the school and the community.

The length of the pre-school conference varies from 2 to 20 days. The most frequently reported length in days was 5, the median was 4, and the average was 4.1.

Other characteristic features of the pre-school conference were reported by percentages of the 177 selected school systems as indicated: (1) cooperative planning, 67 per cent; (2) attendance required of all certified personnel, 84 per cent; (3) responsibility for directing the conference assumed by the superintendent or his designated assistant, 70 per cent; (4) use of special speakers, 79 per cent; (5) use of special consultants, 84 per cent; (6) records and reports made of proceedings, 61 per cent; and (7) conference evaluations made, 51.9 per cent.

Values realized from the pre-school conference in order of importance as reported by respondents are: (1) better orientation of new teachers, (2) improvement of instruction, (3) smoother opening of the school year, (4) improved faculty morale, and (5) improved school public relations. Microfilm \$2.40; Xerox \$8.40. 184 pages.

THE STATE'S ROLE IN PUPIL TRANSPORTATION IN NEVADA

(L. C. Card No. Mic 59-1849)

Joseph Michael Kingsley, Ed.D.
University of Southern California, 1959

Chairman: Professor E. H. LaFranchi

The purpose of the study was to (1) establish state-wide criteria for pupil transportation; (2) determine proper placement of responsibility for achievement of the standards with the state, the local school unit, or a combination of the state and local school unit; (3) compare the resulting criteria with Nevada pupil transportation standards and practices during the 1957-58 school year.

Sixty-five responding specialists designated appropriate pupil transportation standards and placed responsibility for the standards in the following five categories: entirely state, primarily state, equally state and local school unit, primarily local school unit, and entirely local school unit. A comparative analysis was made between the resulting criteria and Nevada standards and practices.

Findings. Generally, items dealing with safety were adjudged as either total state responsibility or primarily state responsibility. Items involving adequacy and efficiency in pupil transportation were considered to be the equal responsibility of the state and the local school unit. Items involving economy and record-keeping were considered to be primarily the responsibility of the local school unit. None of the ninety suggested standards fell within the totally local unit responsibility category, and ten items were rejected as criteria at any level.

Nevada standards and practices are in accord with criteria requirements on approximately one third of the eighty criteria, one third are partially in accord with criteria requirements, and one third are not in accord with criteria requirements. Where regulatory statutes do exist for state responsibility items, they have frequently been discretionary rather than mandatory for local Nevada school units.

Conclusions. (1) Nevada has made great strides in pupil transportation since the appointment of a State Transportation Consultant. (2) Local Nevada school boards have great autonomy in every area of pupil transportation. (3) The definition of specific authority for standards is frequently vague. (4) Specific responsibility is often neglected by both state and local school units. (5) The Nevada State Department of Education provides very limited assistance to local Nevada school districts.

Recommendations. (1) The present position of Nevada State Transportation Consultant should be changed to Nevada State Transportation Director. The Director should be assigned at least one "field man" for inspectional duties and to advise local districts. (2) The Nevada Legislature should allocate 1 per cent of the total state pupil transportation budget to the office of the State Transportation director. (3) The State Transportation Director should develop and require a "special school bus driver's license." (4) The State Transportation Director should develop a comprehensive school bus driver handbook and a maintenance handbook. He should also establish (a) reasonable but flexible maximum walking distances for students, (b) a more equitable transportation apportionment formula, (c) minimum insurance coverage on all school buses, and (d) a program for the mentally and physically handicapped. (5) The State Superintendent of Public Instruction should appoint a State Transportation Advisory Board which would act as a final authority on all pupil transportation disputes in the state. Microfilm \$4.95; Xerox \$16.60. 386 pages.

DIFFERENCES IN PERSONAL AND PROFESSIONAL CHARACTERISTICS OF A SELECTED GROUP OF ELEMENTARY TEACHERS WITH CONTRASTING SUCCESS RECORDS

(L. C. Card No. Mic 59-2400)

Helen Murray Kleyale, Ph.D.
University of Pittsburgh, 1959

The purpose of this investigation was to follow into the teaching profession 108 graduates of Duquesne University, Pittsburgh, Pennsylvania, who were currently teaching in the elementary schools within a restricted metropolitan area.

Answers to three questions were sought:

1. To what extent as revealed by the composite ratings on the Beecher Teaching Evaluation Record did the teachers in the highest and lowest quarters of the group of 108, differ from each other in respect to definite characteristics?
2. To what extent may these differences have been observed or measured during the pre-service education of these teachers?
3. To what extent may be the pre-service data have been employed for predictive purposes?

The teachers were rated on the Beecher Teaching Evaluation Record by the writer and two competent supervisors from the particular district in which the individual taught. The composite rating served to rank the teacher, and these ratings became the criterion against which all data were measured. Coefficients of correlation ranging from .66 to .88 showed that a fairly high degree of relationship existed among the evaluations of the three raters. Since the design of the study was to compare teachers with contrasting success records, the group was divided into quarters, and the highest and lowest quarters were more intensively analyzed and compared. Each of the teachers in the total group was interviewed and asked to complete the Minnesota Teacher Attitude Inventory.

Coefficients of correlation involving the total group were computed in all instances where the differences between the means of the terminal quarters were found to be statistically significant. Intercorrelations were sought among the significant variables, and a multiple regression equation was determined. Each variable selected was weighted differentially in terms of beta weights for maximum predictive purposes.

Findings were reported as they pertained to the evaluation instrument used and to the pre-service and in-service data, as these results were considered both in combination and separately.

The major findings were as follows:

1. On the Beecher Teaching Evaluation Record the difference between the mean score of the highest and lowest quarter was significant, but there was no difference between the mean scores of the men and women teachers.
2. Negligible differences were found between the two extreme quarters relative to the factors of age, sex,

salary, years of experience, grades or subjects taught, credits earned beyond the Bachelor's degree, personal appearance, health, vitality, cooperation, grade in student teaching, reading ability, and attitude toward the profession.

3. Significant differences were found between the contrasting quarters for the factors of: emotional maturity, adaptability, interest in the profession, sociability, performance on psychological and achievement tests, and the University quality-point average.
4. A multiple correlation coefficient of .76 showed that the variables of emotional maturity, results on the Purdue English Test and the optional form of the National Teacher Examinations, as well as the quality point average, when considered together were the best predictors of teaching success for elementary teachers.

The following conclusions appear to be justified from the data examined:

1. Only a few of the personal and professional characteristics studied seemed to show some relationship to teacher merit.
2. Effective teaching seems to depend upon a number of complex factors of which none is clearly differentiating.
3. Notwithstanding obvious limitations of the data, and the cautions which must be exercised in using a predictive device, it would seem that the regression equation which utilizes four variables associated with teaching, namely emotional maturity, results on the Purdue English Test, the optional form of the National Teacher Examinations, and the quality-point average, may implement the selection of teachers at the elementary level.

Microfilm \$2.30; Xerox \$8.00. 175 pages.

ADMISSION PRACTICES AND THE SUCCESS OF SPECIALLY-ADMITTED STUDENTS AT THE UNIVERSITY OF NEW MEXICO AND SELECTED STATE COLLEGES IN NEW MEXICO, 1935-1955

(L. C. Card No. Mic 59-1852)

Winfred John Lincoln, Ed.D.

University of Southern California, 1959

Chairman: Professor E. H. LaFranchi

The purpose of this study was to determine (a) what changes in admission requirements had been made in colleges in the state of New Mexico during the years 1935-55, (b) how effective such changes were, and (c) what additional changes would be desirable.

A study was made of the admission practices. Interviews were conducted with administrative officials at the selected schools, time consumed in securing degrees was compiled, grade-point records were studied, and dropout records were analyzed. At New Mexico Western College statistical comparisons were made between the records

of the specially admitted graduates and those admitted by high school diploma.

Findings. Every college in the study faced the problem of specially admitted students; all departments and schools, with the exception of home economics, were involved. The state-wide schools required much more in the way of entrance requirements for both groups than did the regional colleges. The regional colleges were much more dependent for enrollment on the specially admitted students. Specially admitted students at the state colleges had earned about the same amount of high school credit before withdrawing from high school.

Materials on the G.E.D. tests covering mathematics and expression caused the most difficulty, while the natural and social sciences caused the least difficulty. G.E.D.-admitted students had considerable difficulty in translating acceptable scores in the natural and social sciences on the G.E.D. tests into acceptable letter grades in the corresponding college classes.

The two schools requiring higher passing scores on the G.E.D. tests had much less difficulty with academic failures than did the schools following the recommended passing scores. A high percentage of failures for students admitted by G.E.D. tests were concentrated among those receiving less than a standard score of 50.

The dropout record of G.E.D.-admitted students was high at all institutions during the first year of admission.

Conclusions and Recommendations. It was concluded that liberalized admission practices in New Mexico are consistent with practices in other colleges and that the use of the G.E.D. tests is sanctioned by practice and the success of the students admitted. The standards for admission by G.E.D. tests have been set too low by many of the schools as evidenced by the academic record achieved by those admitted on standard scores of less than 50. One of the big advantages of admitting by high school diploma was in the stability of the group.

In order to meet some of the faults of G.E.D. admission, it is recommended that the passing score be established at 50 rather than 35. It is recommended that a special counseling service be established for specially admitted students to help them plan their program in the light of their background and academic preparation. It is also recommended that the state of New Mexico move as rapidly as possible to the establishment of a comprehensive junior college system and a program of adult education for those students lacking the traditional preparation for college but desiring further training.

It is recommended that the state schools attempt to determine critical scores on the G.E.D. tests based on test scores made by high school seniors in the state of New Mexico.

It is recommended that the schools direct their attention to continuing studies regarding (1) the dropout rate, (2) the characteristics which the G.E.D. tests are failing to measure and which seem essential to success in college, and (3) the cost of education and the values received by those students remaining in college only one or two years.

Microfilm \$4.50; Xerox \$15.00. 349 pages.

**PRACTICES AND PROCEDURES IN RECOMMENDING
AND SCREENING CANDIDATES FOR THE POSITION
OF SUPERINTENDENT FOR PUBLIC SCHOOL
DISTRICTS IN CALIFORNIA**

(L. C. Card No. Mic 59-1854)

Rodney Stone Mahoney, Ed.D.
University of Southern California, 1959

Chairman: Professor D. Lloyd Nelson

The purpose of this study was to investigate, describe, and evaluate the status of practices and procedures in recommending and screening candidates for the position of superintendent for public school districts, and to make recommendations based on the findings.

There were 153 administrative units whose governing boards had employed a superintendent of schools between October 1952 and October 1957 which were sent an anecdotal-type questionnaire regarding the various aspects of the selection procedure utilized in employing their chief administrative officer. A total of 105 questionnaires (69 per cent) were completed and returned by these administrative units which represented 121 public school districts.

All 58 county superintendents of schools were sent a check-list questionnaire to determine the extent and types of professional assistance provided in this selection procedure by their offices. Fifty-three offices completed and returned the questionnaire, and 49 were tabulated and utilized in the study.

Nine state colleges, 4 private colleges or universities, and 3 state universities were included and sent this check-list questionnaire. All 16 completed the questionnaire, and the answers were tabulated and utilized in the study.

Findings. (1) Nine procedures were reported utilized by public school districts in employing the superintendent of schools. Sixty-one administrative units (58 per cent) utilized the services of professional educators in the selection procedures established, while 44 (42 per cent) developed their selection procedures without professional assistance. (2) Nineteen (31 per cent) of the 61 units which utilized the services of professional consultants reimbursed them. (3) Seventy-three (70 per cent) of the 105 respondents reported that their boards developed a set of qualifications for the position. (4) The same number reported that there was a preliminary screening of candidates included in the selection procedure. (5) Eighty-nine (91 per cent) of the respondents concluded that professional assistance at the final meeting held to select the superintendent was not desirable. (6) Thirty-five (72 per cent) of the offices of county superintendent of schools included in the study provide consultant service to public school districts in this selection process. Fifteen (94 per cent) of the colleges and universities included provide this service upon request.

Conclusions. (1) Professional assistance in the selection of a superintendent of schools has benefited school district governing boards when a superintendent is to be employed. (2) A professional screening committee will, in most instances, provide valuable assistance in selecting a chief administrative officer. (3) There are many types of professional assistance provided and utilized by school boards.

Recommendations. It is not possible, nor desirable, to propose a specific procedure to be followed in employing a

superintendent of schools. The exigencies of each district determine the specific phases of the selection process to be employed, minimized, or omitted.

There is, however, a general pattern to be recommended. The following recommendations are based on the data obtained from this study and from the treatment of the data: (1) School boards should decide first whether or not an employee is to be promoted to the position. (2) An assessment of the professional assistance available should be made. (3) Consideration should be given to the utilization of a professional screening committee. (4) Final selection of the superintendent of schools should be the sole responsibility of the school districts governing board. There were five additional minor recommendations included in the study. Microfilm \$4.55; Xerox \$15.20. 353 pages.

**HISTORY AND DEVELOPMENT OF THE
PENNSYLVANIA DEPARTMENT OF PUBLIC
INSTRUCTION TO 1945**

(L. C. Card No. Mic 59-2249)

Eugene Mateer McCoy, Ph.D.
University of Pennsylvania, 1959

Supervisor: William B. Castetter

The continuing history of education in Pennsylvania is presented, from its confused beginning with private schools and tutors among transplanted old-world nationalities and religions, and reveals the development of the public conscience concerning the education of the children of families less well off, resulting in pauper school laws of 1802, 1804, 1809, and 1810, but not establishing public schools. Philadelphia moved in 1812 toward public schools, with Robert Vaux as First Administrator 1818-1831; the state arrangement continued as tax-aided private education until 1834.

The wide effort for public schools was rewarded in 1834 by the passage of "An Act to Establish a General System of Education by Common Schools." Opposition solidified, and a motion ye repeal passed in the State Senate. Thaddeus Stevens' famous speech of April 11, 1835, reversed the tide, and the public school system was not again dangerously threatened. The first Act authorized \$75,000 to allocate to school districts. Contemporary estimates show about 400,000 children of ages five to fifteen in the state, of whom only 37 per cent were receiving some sort of education.

In the early days the Department of Public Instruction, and particularly its Superintendent, had to coax, cajole, and threaten in order to arouse interest in and acceptance of the value of education for children. By 1852, however, the number of schools, pupils, and teachers had multiplied by from 12 to 14, but with the total money available diminished by half. From 1834 to 1850, pay for male teachers averaged in the neighborhood of \$18 a month, for women, \$10. By 1902, these figures had climbed to \$45 and \$34. County superintendents in 1884 averaged \$440 a year. The school term for many schools in 1850 was three months.

From 1834 to 1945, twenty-five different state superintendents carried on their supervisory and administrative duties and, usually with the help of the contemporary governor, worked for legislation to improve the schools. Their

burdens grew with the years. Every report carried some plan to improve the quality of teaching and emphasized the need to arouse interest in teaching, to which over the years were added certification, salary improvement, tenure, and retirement plans. Buildings were a constant concern, through such elementary steps as the preparation of suitable plans and insistence on fire escapes to the inclusion of special facilities for libraries, music, art, physical education, vocational training, home economics, agriculture, care and education of the handicapped, and audio-visual education. The superintendent and the department worked ceaselessly to extend the term beyond three months, to provide uniform instruction and free textbooks in graded schools, to end child labor, to house, maintain and educate soldiers' orphans, to make education compulsory, to provide continuation schools, to educate immigrants, to provide adult and extension education.

It was necessary to fight off opposition to the school system; notable was an attack based on a claim that education increased delinquency. There was unwarranted assertion of mismanagement of soldiers' orphan affairs.

The schools were and are only a part of the burden. In 1909 the Bureau of Medical Education and Licensure and the Bureau of Professional Education came under the Superintendent of Public Instruction. More than a dozen trades and occupations requiring special examination and license have since been added to the list.

Under the Department of Public Instruction the schools and related departments and agencies assisted in every phase of the war effort, 1941-1945, and have become a service agency for every citizen of every age, regardless of color or creed.

Microfilm \$6.25; Xerox \$21.80. 492 pages.

**A STUDY OF THE EQUALIZING INFLUENCE OF
A TOTAL COUNTY VALUATION OR A COMBINED
LOCAL DISTRICT VALUATION ON THE SCHOOL
FINANCE PROGRAM IN OHIO FOR
THE YEARS 1955, 1956, 1957**

(L. C. Card No. Mic 59-2403)

Harold A. Meyer, Ed.D.
University of Pittsburgh, 1959

The study (1) traces historically the attempts made by the State of Ohio to secure some form of equalization in the distribution of state funds to provide adequate educational opportunities to the youth; (2) examines in detail the 1308 school districts in 1955, the 1253 school districts in 1956, and the 1175 school districts in 1957 with in regard to their total valuation and their average daily membership; and (3) proposes certain recommendations in providing even greater equalization of the educational burden among the citizens of Ohio.

The survey covers a three-year period and uses the 1953 tax valuations used in determining taxes payable in 1955 together with the 1955 average daily membership figures used in calculating the foundation program payments; the 1954 tax valuations used in determining the taxes payable in 1956 together with the 1956 average daily membership figures; and the 1955 tax valuations used in determining the taxes payable in 1957 and the average daily membership figures for 1957.

The procedure followed in compiling the data for study is as follows:

On a separate work sheet for each of the 88 counties a list of all districts is made, starting with the city district, then the exempted village districts, and followed by all local districts.

The tax valuation for each district as found on the Financial Report of the Board of Education is placed in the appropriate columns.

The average daily membership figures as ascertained from the Certified Average Daily Membership report is placed on the work sheet.

The valuation per pupil for each district, each county, and for all local districts is computed.

The number of pupils affected favorably by a change in valuation, using either the total county valuation or total of the local districts only, is noted.

Using the total county valuation it is noted that 571,888 students, or 42.4 per cent of the 1,348,461 pupils in attendance in the year 1955, will be aided by increased valuation. For the year 1956, 42.3 per cent of the total attendance of 1,415,773, or 559,092 pupils will benefit by the use of a combined valuation. In 1957, of a total of 1,530,154 students, 42.5 per cent of them or 650,906 will be aided by increased valuation.

The results show that where all local districts within the county are combined, the majority of the students will be benefited with an increased valuation. In 1955, of the 514,022 students enrolled in local districts, 317,674 or a percentage of 61.80 will be affected favorably. In 1956, 62.17 per cent of the 542,701, or 337,407 pupils will gain by such a consolidation. For the year 1957, the situation remained pretty much the same with a percentage of 62.07 of the 588,061, or 365,025 of the pupils in attendance, gaining in per pupil valuation.

The use of the entire county as the taxing unit is not recommended at the present time because it will penalize more students than it will help. Equalization by lowering standards, requirements, or valuation per pupil cannot be justified in this instance.

The combining of valuation of only local districts may have some merit if equalization within counties is desired. Administratively, they could be combined quite effectively and because Ohio already levies and collects taxes on a county basis, the collection and distribution of tax money would only be routine. When 62 per cent of the youngsters involved would be aided by such a program it deserves consideration.

A plan for total equalization on the state level is recommended as the only way to provide for the great differences in valuation among counties as well as districts.

Microfilm \$6.35; Xerox \$20.00. 449 pages.

**A STUDY OF LEADERS AND LEADERSHIP IN A
DEVELOPING FRINGE COMMUNITY WITH
IMPLICATIONS FOR EDUCATIONAL LEADERS
IN FRINGE COMMUNITY SCHOOLS**

(L. C. Card No. Mic 59-1336)

Cyril Merton Milbrath, Ph.D.
Michigan State University, 1957

Supervisor: William H. Roe

This study was concerned with leadership in a developing fringe community as compared with leadership in stable mature communities. It also was an attempt to look at the school from the community viewpoint through the eyes of community-wide leaders. The ultimate purpose was to determine an acceptable community development and leadership role for educational leaders in a developing fringe community.

The study was based upon the premise that what leaders feel and believe makes an important difference in the social policy of a community. The research developed out of two major needs concerning community organization. The first need was for more detailed information concerning leadership in developing fringe communities, and the second was for an understanding of the leadership and community improvement roles of the school in a rapidly changing social system.

The fringe, referred to as a new sociological frontier, had not been studied in depth in relation to leadership. For this reason the depth interview technique was employed in a case study of the Warren School District, geographically located in the northeast fringe area of Detroit, Michigan.

The primary focus was upon the completed social profile which gave a picture of the social structure, the social policy, and the leadership pyramid. The top leaders were then interviewed concerning their attitudes and beliefs about their community and the role of the school in community life.

The major hypothesis was stated as: Leadership in the Warren fringe area is significantly different from leadership in a stable mature community. A second hypothesis related to the first was that: The school as a social institution has a different, more important role to play in a developing fringe community.

The seventeen top leaders were interviewed to determine their attitudes toward social change, the community improvement role of the school, newcomers in the community, and the acceptability of the community school concept. The study employed valid sociological techniques and methods to gain the information needed to understand the role of the school.

The findings in the study showed that leadership in a fringe community is significantly different. The community lacked social cohesion giving a leadership picture of a low flat pyramid with a broad base. Leadership was hampered by ineffective communication at the lay citizen level and an inadequate number of capable leaders interested in community improvement. In such a social situation, due to a fluid population and a changing social policy, the schools and churches were called upon to accept different and more important social and leadership roles in the developing fringe community.

Other findings of the study were: formalized authority was a prime determinant of a lay citizen's image of a

community leader; leadership roles pivoted around institutional problems; community progress was measured in terms of expediency rather than planned goals or objectives. Leaders' attitudes were positive toward change, paralleling the kind of leadership common to America's pioneer era. A new kind of leadership, commonly termed group-centered democratic leadership, was required which permitted the inclusion of newcomers to the fringe and provided for leadership training at the same time as problems were being solved. The findings of the study point toward an education-centered community in which the community school as an effective tool in the hands of educational leaders can assist all groups in developing an improved and more desirable human community.

Microfilm \$3.25; Xerox \$11.20. 251 pages.

**A STUDY OF STUDENT PERSONNEL SERVICES
IN SIX LIBERAL ARTS CHURCH COLLEGES**

(L. C. Card No. Mic 58-5312)

Leslie Parrott, Ph.D.
Michigan State University, 1958

The Problem. The purpose of this research was to study the student personnel services in the six liberal arts colleges of the Church of the Nazarene. This was done from three aspects: (1) The perceptions of the administrations concerning the available student personnel services, (2) the perceptions of the students and faculty concerning available student personnel services, and (3) the student's own perceptions of their problems.

Methodology. The administration's perceptions of student personnel services were determined by printed and mimeographed materials and by interviews. The student and faculty perceptions of available student personnel services were determined by the administration of an original questionnaire based directly on the eleven areas of the Mooney Problem Check List. The student's perceptions of their own problems were ascertained by their responses to the Mooney Problem Check List. The check list and questionnaire were administered to a 50% random sample of students attending a regularly scheduled chapel period at each of the six colleges in early November 1957.

The Chi-square statistic was considered appropriate for this type data. Using the Chi-square tests of differences (1) The freshman, senior, and faculty perceptions of student personnel services were contrasted within the six colleges, (2) and the male freshman, female freshman, male upperclassman, female upperclassman, and married student perceptions of their own problems were contrasted between the six colleges.

One inclusive basic null hypothesis was tested.

There will be no differences in the awareness of students and faculty to available student personnel services perceived by the administrations and there will be no difference in the proportion of problems indicated by the students on all eleven areas and for each specific area of the Mooney Problem Check List for each of the six colleges.

The Findings. Administrators perceived a program

in force which was designed to meet student problems. At the .05 level of significance, there were significant differences between the perceptions of students and faculty concerning several student personnel services. Further, there were significant differences between the six colleges for certain student groups who indicated their total number of problems and their problems of most concern on the Mooney Problem Check List.

Conclusions and Implications. The results indicate the need for clarification of communications concerning student personnel service.

Not only are there discrepancies in perceiving these perceptions, but all student and faculty are not aware of the services available.

No attempt was made to isolate specific differences internal to colleges in relation to student's perceptions of their own problems. However, it is evident that students in certain colleges have more problems and are more concerned about problems in some areas than in others. These indications suggest the need for a more penetrating analyses of the student personnel services which relate to particular types of problems.

Recommendations. The next logical step in this study would be to evaluate the student personnel services now perceived to be related to the student problems identified in each of the six colleges.

Further, an investigation of the student personnel services relating to specific areas of student problems as identified by the Mooney Problem Check List should be given special attention by the six college administrations. Included are the specific areas of "Social Recreational Activities," "Social Psychological Relations," and "Adjustment to College Work."

A better orientation of faculty and students plus improved communications concerning existing student personnel services are needed.

Because of the acute differences between colleges both in student personnel services and the identification of student problems, these recommendations need to be carried out on each campus independently.

Microfilm \$2.95; Xerox \$10.20. 227 pages.

ATTITUDES OF CITIZENS RELATIVE TO SELECTED PRINCIPLES OF PUBLIC SCHOOL FINANCE

(L. C. Card No. Mic 59-2405)

Ralph R. Redo, Ed.D.
University of Pittsburgh, 1959

The purpose of this study is to ascertain the attitudes of citizens relative to the public school finance principles of adaptability, democracy, equalization, and prudence; and to determine whether sex, age, occupational status, marital status, school patronage, educational status, economic status, and religious preference had any influence with respect to these principles.

The problem was delimited to ten selected school districts in Western Pennsylvania.

In order to collect data for this study, a questionnaire was constructed. Nineteen nationally known public school educators reacted to the statements in the questionnaire, and those statements were considered valid to which at

least 75 per cent of the jury reacted in unanimity. The questionnaire was then subjected to a pilot study to determine the suitability of the statements. The survey instrument was then ready for the field survey which was conducted through the school districts of each community surveyed. The superintendents of each of the ten school districts agreed to cooperate. In eight of these districts high school students acted as field representatives. PTA members were used in the same capacity in two of the districts. The students and the PTA members were instructed relative to the procedures to be used in conducting the survey.

Criteria for selecting the citizens were predetermined so as to obtain an adequate sampling of the population surveyed. Each field worker contacted five citizens. He did not interview the citizens, but left a questionnaire with each of them to be filled in by the citizen. The questionnaires were then picked up in a day or two by the field workers and returned to the various high schools. The completed questionnaires were then picked up by the writer.

In each of the ten school districts surveyed, 120 citizens were to be contacted. Therefore, the total number of useable questionnaire returns expected was 1200. From this possible total of 1200, 989 useable questionnaires were returned by the field workers.

After analyzing the responses, it was concluded that there were significant differences in attitudes toward the selected principles of public school finance existing between the jury and the respondents. The greatest difference was found in the statements pertaining to the principle of equalization, while the statements on the prudential principle elicited the greatest number of favorable responses from the citizens.

Age, sex, and marital status had no significant effect upon the attitudes of the respondents.

Religion affected attitudes. Protestant respondents scored higher than Catholic respondents.

The professional group of respondents rated higher in their attitudes concerning school finance principles than any other occupational group. There were no significant differences between the commercial-clerical groups, the service-housewife groups, the service-manufacturing groups, and the housewife-manufacturing groups.

Respondents with children in public schools scored higher than respondents who had children in the parochial schools and those who had no children in school. No difference existed between respondents with children in public schools and those who had children in both the public and parochial schools.

It was found that the greater the amount of education, the closer the attitudes of the respondents came to matching those of the jury.

Even though no real difference was found to exist between the low and middle economic groups, significant differences were found to exist between the high economic group and both of the other two groups.

In the light of the evidence presented, the attitudes of the respondents in the communities surveyed are generally more favorable than unfavorable toward the selected principles of public school finance; and the selected social characteristics, in some cases, affected the attitudes of the citizens toward these public school finance principles.

Microfilm \$2.00; Xerox \$6.40. 133 pages.

A COMPARISON OF TEACHER JUDGMENTS AND MULTI-FACTOR TEST SCORES AS PREDICTORS OF PUPIL CAPACITY

(L. C. Card No. Mic 59-1806)

Bernice R. Roberts, Ed.D.
Wayne State University, 1958

Adviser: Charlotte W. Junge

Despite the fact that teacher judgment of pupil capacity has been held in low esteem, it was the purpose in this study to show the relationship between the teacher prediction of pupil capacity and the prediction of pupil capacity by a multifactor mental abilities group test. It was a further purpose in the study to discover aspects which seem to influence or vary the relationship for some groups of children in certain situations.

The study involved four hundred fourth grade pupils in the elementary schools of a midwestern suburban city. Forty-one elementary teachers who had taught or were teaching the pupils participated in the study also.

The study setting, the teacher-subjects, and the pupil-population were described. Six major issues were pursued through the study design. The relationship between teacher prediction and test prediction of pupil capacity was sought in its total proportion and in the aspects involving: varying amounts of time employed by the teachers in observing pupils; the pupil sex factor; teacher perception of pupil industry, economic status and personality; the overestimation and underestimation of pupil ability and the possible influence of such factors as class size, length of teaching experience and individual teacher range in the teacher judgment-test score relationship.

Pearsonian zero order coefficients of correlation, first order partial correlations, coefficients of determination, Fisher's z ratio values, percent tables, histograms, and tallies were methods and instruments used to discover and depict the study findings.

The findings revealed a statistically significant relationship between teacher judgments and test scores. Teachers and test scores seemed in greatest agreement as they predicted the intelligence factor which measured Verbal Meaning Ability (.54 and .61) and the total measurement of intelligence (.58 and .59). Number Ability predicted by teacher judgments and test scores came next in agreement (.40 and .43). Reasoning (.42 and .38), Spatial Ability (.37 and .36), and Perceptual Speed (.32 and .28) yielded far less substantial agreement between teacher judgments and test scores.

While statistically significant in correlation, the relationship was regarded as of meager "professional" significance. Teacher judgments, as well as test scores, should be regarded as somewhat unreliable single predictors of pupil intelligence.

Teacher judgments and test scores (especially in Number Ability, .50 and .32) were statistically different when boys' capacities were predicted in comparison to the prediction for girls. Also, teachers who knew the children for approximately six weeks were in greater agreement with test scores (.61) than teachers who knew children for a full school year in the prediction of the Verbal Meaning Ability (.54).

Teachers were more often underestimators of pupil capacity than they were overestimators.

Teachers' perception of pupil industry seemed to be the only variable which when held constant affected the magnitude of the teacher judgment-test score relationship.

Teacher judgment intercorrelation among the factors of intelligence were higher (.83) than factor test score intercorrelations (.39).

While teachers seemed to have improved in the judgment of pupil capacity since Terman's study in 1916, there remains much to be done in the improvement of teacher and test prediction of pupil capacity in order that the curriculum be designed to make the most of pupil potential.

This study's findings have implications for the classroom teacher, curriculum workers, school administrators, and planners for institutions of higher learning. In an era of educational reappraisal, it was suggested that the named groups work toward a better knowledge of pupils through fundamental research aimed toward the development of teachers' critical analysis through the provision of guides for the recognition and observation of factors of pupil intelligence especially Spatial Ability and Perceptual Speed.

Microfilm \$2.35; Xerox \$8.20. 178 pages.

THE DEVELOPMENT OF STATE SCHOOL ADMINISTRATION IN NEBRASKA

(L. C. Card No. Mic 59-1790)

Otto George Ruff, Ph.D.
The University of Nebraska, 1959

Adviser: Leslie Lee Chisholm

With the passage of the first statute establishing schools in the Nebraska Territory in 1855, provision was made for a chief state school officer. This officer was charged with the duties of administering the school laws, supervising the schools, and reporting periodically to the governor and the legislature. Educational progress during the thirteen years of Nebraska's territorial status was slow because of a number of reasons, chief among which were the greater concern of the people to provide for their own livelihood, the limited population of the territory, inadequate financial resources, and the lack of adequate communications.

The situation began to improve after Nebraska achieved statehood in 1867, and again after the office of state superintendent of public instruction was firmly established by the state constitution and the statutes in 1875. The relatively rapid turnover of the incumbents, the failure of the legislatures to act promptly upon needed legislation, the lack of adequate appropriations, and the seemingly indifferent attitude of the people toward the efforts of the chief state school officer were reflected in the retardation of educational progress at the state level to 1890. Thereafter, a number of significant gains were made, which included the enactment of compulsory education laws, free high-school attendance laws, and free textbook laws; the establishment of three additional state normal schools, eight junior normal schools, and the normal training course in high school; the raising of requirements for the certification of teachers; and the provision of state aid for weak districts and various vocational courses in high school.

The most significant educational progress at the state level in Nebraska was made after 1920. During this period,

further progress was made in effecting improvements in the educational programs in the private, parochial, and denominational schools as well as in the public schools by revising and strengthening the courses of study, expanding the supervisory services, improving the reporting procedures, and adopting new procedures for approving and accrediting the schools of the state.

New emphasis was given to teacher education, and the requirements for teachers' certificates were raised. The superintendents of public instruction were successful in establishing the principle that Federal aid funds for various educational programs should be channeled through the State Department of Education. During this period, new educational programs were established for the education of adult immigrants and of physically handicapped children; laws were passed for the establishment of public junior colleges; and the Nebraska State Trade School was established. New emphasis was given to character education and citizenship education, and the school laws were recodified. To accomplish these gains, the staff of the department was increased materially, and the appropriations were significantly increased. Contributing to the growth in the number and in the importance of the services rendered by the State Department of Education, was a recognition of the importance of good public relations, and the implementation of such a program.

Two major problems confronting education in Nebraska -- school district reorganization, and public school finance -- were identified early in her history. Despite many efforts to reach a solution to them, these problems remain unsolved.

Progress in state school administration in Nebraska was characterized by its lack of uniformity brought about both by human foibles and by economic considerations.

Microfilm \$3.60; Xerox \$12.20. 277 pages.

BOARD-ADMINISTRATOR DELEGATION OF AUTHORITY IN PURCHASING AND PERSONNEL

(L. C. Card No. Mic 59-1860)

Jack Robert Sadler, Ed.D.
University of Southern California, 1959

Chairman: Professor D. Lloyd Nelson

The purpose of this study was to determine the proper delegatory relationship and division of function between California school boards and their professional staffs in the areas of purchasing and classified personnel.

The method of study involved the examination of three primary data sources: (1) the field literature and findings of existing research, (2) the legal statutory and case law field, and (3) the practices, procedures, and controls found in ten highly select and "leading" school districts, cities, and county. Each of the participating governmental units was visited and studied until an accurate description of its true functionings in the study areas could be recorded. Data were collected by literature review, legal research, review of policy documents, observations of actual practice as pursued by directors and staff, and by interviews with administrative staff members.

Findings. (1) The contract acts of purchasing and

classified employment were found to be statutorily assigned to the lay school board. (2) The courts had determined that the powers to contract for the purchasing act and the employment act were discretionary powers and, in the absence of statutes so authorizing, could not be delegated and performed by the professional staff. (3) The selected school districts were engaged in administrative procedures which clearly illustrated that the contract acts of purchasing and employment were considered in practice as executive acts, and were not treated as the proper subjects for lay board deliberation. Indirect delegation of authority was achieved by various extralegal procedures, and by ceremonial ratification of professionally consummated contracts by the lay board. (4) The cities and county were operating under statute, charter, ordinance, and policy structures which gave clear legal authority for the contract acts of purchasing and employment to be performed by a professional staff. In keeping with such legal authority, all of the non-school agencies had provided full delegation of these acts to the administrator. (5) Contract acts in both school and nonschool agencies were being executively performed within comprehensive policy controls adopted by the governing bodies.

Conclusions. (1) In theory the school board's area of activity is involved primarily with the formation of basic and controlling policy and the audit-evaluation of the execution of policy, while the professional staff's area of activity is the execution of these policies. (2) Between the points of establishment of basic and controlling policy and the audit-evaluation of the execution of these policies, the acts of purchasing and employment of classified personnel are executive acts. (3) The existing legal structure in California does not allow these acts to be performed by the executive. (4) Statutory patterns, not inconsistent with the public interest as expressed by the Constitution, Legislature, and the courts, can and should be developed to allow these acts to be performed as executive functions by the professional staff. (5) School administrators, in the name of practical necessity, are forced to operate in an area of illegality, misrepresentation, and potential personal liability.

Recommendations. (1) A detailed program of corrective legislation is recommended in the study. The program essentially calls for permissive legislation which would allow school boards to delegate the contract acts of purchasing and classified employment. Such delegation of authority would be performed within certain legislative restrictions and safeguards. These restrictions and safeguards include, among others, the establishment of control policy and the audit of policy execution by the lay board.

Microfilm \$3.90; Xerox \$13.20. 301 pages.

**SUPERIOR PRACTICES IN THE ADMINISTRATION
OF INDUSTRIAL ARTS TEACHER EDUCATION.**

**A STUDY OF THE ATTITUDES OF LEADERS
TOWARD DERIVED STANDARDS WITH REFERENCE
TO THE PROJECTION OF AN ADMINISTRATIVE
PROGRAM FOR CALIFORNIA.**

(L. C. Card No. Mic 59-1600)

Leslie Earle Stephenson, Ph.D.
The Ohio State University, 1958

The dissertation pertains to the derivation of superior administrative practices, utilizing the literature of higher education, and to the attitudes of leaders toward these derivations. This is largely a study of the standards of organization and administration of industrial arts education which includes-

1. A resumé of the historical development of the organization and administration of higher education for the purpose of
 - a. determining the significant changes in organization and administration since their first concept.
 - b. ascertaining the attitudes of leaders in the field toward organization and administration.
2. A resumé of the historical development of industrial arts for the purpose of
 - a. presenting the reader with a brief overview of the program.
 - b. describing significant changes which have affected the program during the past half century.

The entire study is postulated on the belief that the solving of educational problems requires an investigation of leaders' attitudes and experiences, and that-

1. Confusion in contemporary administration of industrial arts education can be traced partially to conflicts among the policies which govern administrative acts of the departments.
2. There exists, in spite of the confusion in American higher education, a tendency toward a consistent view point among theorists and administrators who contribute to the literature.
3. By an application of scientific procedures, the elements of this philosophy could be constructed from the writings of accredited leaders in the field of higher education.

Purposes of the Study. The purposes of this study were-

1. To present a modern-day viewpoint with reference to the administration of industrial arts education.
2. To develop a valid list of practices to serve as an administrative guide in the development of these programs.
3. To study those administrative practices thought to be superior.
4. To stimulate continuous research with regard to the administration of industrial arts education.

Limits of the Study. This study is limited to those practices of internal administration pertaining to instruction and personnel found in the undergraduate industrial

arts education departments in colleges and universities of the United States.

Pertinent Findings and Conclusions of the Study. It was found that-

1. The formulation of departmental policies and curriculum is a procedure which must undergo constant surveillance.
2. Departmental policies and curriculum must remain flexible, and the philosophy concerning these points must be compatible with institutional policy.
3. Research is essential to the improvement of instruction but its execution rests primarily with the instructors.
4. Departmental administrative personnel must have authority commensurate with their responsibility, but the representation of the department rests with the department head.
5. The organization of a department rests with the staff but the selection of the department head and new staff members rests upon the combined efforts of the staff and the administration.
6. Evaluation of students during their residence should contain criteria other than grades alone.
7. The departmental budget must cover all activities, provide for emergency expenditures, and the replacement of worn-out and obsolete equipment.
8. The institutional planning committee should include a representative of the industrial arts education department.
9. The laboratory equipment must be representative of industry and operated in conformance with industrial safety standards.
10. An honorary professional fraternity in industrial arts education should be included in the professional activities of the department.

Microfilm \$4.40; Xerox \$14.80. 341 pages.

EDUCATION, ADULT

**AN OPINION SURVEY OF AGRICULTURAL
EXTENSION WORK IN ONTARIO**

(L. C. Card No. Mic 59-2690)

Harold Reid Baker, Ph.D.
Cornell University, 1959

Purposes

The purposes of this study were to: (1) determine the degree of consensus of opinion on questions related to extension work between specified groups of government extension workers and farm operators; (2) identified problem areas of current interest to agricultural extension work in Ontario.

Procedures

Opinions and factual data were gathered during the spring of 1958. Two similar questionnaires were used, one for government extension workers and one for farm operators. Those who provided data included:

1. Extension Workers
 - (a) 100 full-time county extension employees
 - (b) 92 part-time extension specialist employees
 - (c) 22 administrators concerned with extension work.
2. Farm Operators
 - (a) 247 farm operators selected randomly by means of an area sample
 - (b) 303 farm operators who were members of a farm organization (Farm Radio Forum).

A number of the administrators and all of the area sample of farm operators were interviewed personally. The remainder received questionnaires in the mail.

Conclusions

The data seem to warrant the following conclusions.

- (1) The present organizational structure of Extension appears to be relatively effective. (2) There appears to be a need for better coordination of extension work. (3) There is a demand from county workers for additional supervision. (4) Extension in Ontario has no generally accepted objectives. (5) The "farm business" is the major problem area cited by farm operators. (6) Farm operators want training in the social science field. (7) Recommendations made by extension workers are usually applicable to most farm operators. (8) Extension workers appear to have an inadequate knowledge of and interest in systematic study to guide their work. (9) Farm operators are confused as to how they can influence the extension program. (10) There is little relationship between "size of farm" and "farmer participation" in extension activities. (11) Extension workers and farm operators most closely associated with Extension have the more favorable attitudes toward it. (12) Extension employees prefer to use a "group" approach in their work but demands from "individuals" seem to make this difficult. (13) Extension workers say they would like to involve representative farm groups in program planning but few do so in practice. (14) The perceived role of the county extension worker is related to the nature of the contact the farmer has with him. (15) Extension workers who are oriented in teaching and research appear to have different opinions on extension work than do county extension workers. (16) The closer extension workers are associated with farmers the more likely will the opinions of the two groups be in agreement. (17) The opinions expressed through farm organizations are not necessarily compatible with those of the farm population as a whole.

Suggestions for Consideration

In light of the data the following recommendations are made.

1. The office of the Director of Extension should have the responsibility, with commensurate authority, to coordinate all government extension work.
2. Administrators should create opportunity for the discussion and definition of useful objectives.
3. An extension publicity program should be initiated.

4. Extension workers should be trained early in their career in the philosophy and attitudes appropriate to them.

5. The role of each extension worker position should be defined and also supported by job descriptions.

6. Additional supervision, on a regional basis, should be provided.

7. The use of provincial and county program planning committees should be considered.

8. A Department of Extension Education should be developed for social science research and teaching purposes.

9. A systematic "sabbatic leave" program should be instituted and all personnel encouraged to improve themselves professionally.

Microfilm \$2.35; Xerox \$8.20. 178 pages.

THE COMMUNITY DEVELOPMENT APPROACH IN EXTENSION WORK IN TENNESSEE

(L. C. Card No. Mic 59-2692)

Lewis Harper Dickson, Ed.D.
Cornell University, 1959

This study is concerned with the rural community development program in Tennessee. Specific purposes of this study are: (1) to define and clarify some of the basic concepts of community development as related to the Tennessee program; (2) to examine the evolution and growth of community development work in Tennessee; (3) to study Extension's role in community development; and (4) to point out some implications of importance with respect to the training of Extension personnel and the future conduct of Extension work.

In 1944, the Tennessee Agricultural Extension Service introduced a new and decidedly different approach to Extension teaching--the community development approach. In this approach, Extension provides professional leadership and other educational assistance to organized community groups interested in developing and executing community programs designed to improve existing social and economic conditions. In essence, community development is an educational process in which the people of a community are assisted by the Extension Service in (1) studying the resources of the community and those available to it; (2) identifying and evaluating community problems; (3) making decisions about community goals and objectives; (4) developing a plan of action designed to accomplish the goals and objectives; (5) organizing the group so as to expedite the plan of action effectively and efficiently; and (6) evaluating the process as well as the results obtained.

Community development as an aspect of Extension work came into prominence in 1944 with the initiation of the East Tennessee Community Improvement Contest. Starting with sixty-four communities in fifteen East Tennessee counties, the contest-centered, multi-interest community improvement program soon spread across Tennessee as well as to thirteen other states in the Southeast. In 1955, over eight hundred rural communities in Tennessee were participating in this program, which emphasized organized planning and action to improve farming, family living, and community life.

Extension's educational responsibility in community organization and development is to develop intelligent

leadership and to assist people in forming good habits of organization and group action. The Extension worker's role in community development is that of a professional leader, and in this role he functions primarily as a stimulator and educator of the community group.

The community development approach enables Extension workers to reach a larger number of people, and it also provides an excellent opportunity for the development of group leadership. Through organized community planning and action, existing organizations and institutions are strengthened. The rate of adoption of recommended farm and home practices is higher in communities participating in community improvement programs than in similar communities not engaged in such programs.

The community development approach does not replace others normally used in Extension Education; rather, it supplements them.

Providing effective professional leadership and educational assistance to organized community groups is a rigorous job which demands thorough professional training. The Extension Service needs to give careful attention to developing training programs adequate to prepare Extension workers for the multiple demands of their profession.

Microfilm \$2.00; Xerox \$6.80. 143 pages.

EDUCATION, HISTORY

A HISTORY OF HIGHER EDUCATION IN PENNSYLVANIA

(L. C. Card No. Mic 59-2266)

Saul Sack, Ph.D.

University of Pennsylvania, 1959

Supervisor: James A. Mulhern

A careful investigation revealed the absence of a basic work in the history of higher education in Pennsylvania. To fill this void this study was undertaken. Preliminary to field investigations, a broad body of literature was explored. Histories of a general nature dealing with the economic, political, and social life of Pennsylvania, from its founding to the present, were studied. State, county and local histories, church histories, publications of historical societies, as well as works dealing with general and special education, were perused to obtain clues to materials concerning the state's colleges and universities. Some long forgotten colleges, and a few which failed to draw a first breath, were found mentioned in the Pamphlet Laws of Pennsylvania. These indicated possible avenues of approach. The heart of the study lay in the primary documents. Minutes of trustees and faculties, letters, diaries, memoirs, reports, catalogues, bulletins, announcements, and student publications, among many other sources, supplied the foundation upon which the history was built. Records of defunct institutions were sought in local historical societies, libraries, newspapers, and county court houses throughout the state.

A study of the materials thus gathered indicated that the history of higher education in Pennsylvania could best

be told if a topical rather than a chronological organization were adopted. Consequently, the study was arranged in four parts, each treating a different aspect of the story. Within the several parts, however, attention was paid to the ordering of events chronologically. At the same time, an effort was made to relate the development of higher education to the environment in which it flourished. Separate chapters were devoted to depicting life in the province and to life in the commonwealth. Throughout the text, the various phases of institutional life and growth were viewed in the light of the social forces which affected them. The materials are organized in twenty-eight chapters: Life in Provincial Pennsylvania; Presbyterian Influence: Origins; Dickinson College; Later Presbyterian Developments; The German Church People; The German Sectarians; The Methodists and Higher Education; Quaker Colleges; Episcopalian Influence; Baptist Colleges and Universities; Catholic Higher Education; Other Church Efforts; Life in the Commonwealth of Pennsylvania; The University of Pennsylvania; The State and Higher Education; The Secular Tendency in Higher Education; Theological Education; Medical Education and Allied Fields; Legal Education; Scientific and Technical Education; The Education of Teachers; Higher Education of Women; The Junior College; The Evolution of the Liberal Arts Curriculum; Graduate Education; The Administration of Higher Education; Student Life and services; and Higher Education in Retrospect.

The study revealed that Pennsylvania's large number of colleges and universities is directly attributable to the efforts of her diverse religious groups. Bound at first by theological tradition and the doctrine of formal discipline, higher education yielded gradually to profound socioeconomic changes, chiefly induced by the industrial revolution, which transformed society as a whole. A process of secularization became evident, which was reflected largely in the curriculum. The old concept of liberal arts, based upon ancient languages, was gradually transformed. The sharp line of demarcation between the so-called liberal and the vocational subjects began to blur, so that, in the mid-twentieth century, education may be designated liberal, regardless of the discipline it includes, if it leaves the individual free to develop as his inclinations and his capacities direct. Other significant findings relate to the emergence of colleges for women, the origin and status of the junior college movement, the college and the community, faculty-trustee relations, the financing of higher education, and expanded services to students.

Microfilm \$14.95; Xerox \$53.80. 1197 pages.

EDUCATION, PHYSICAL

**AN ANALYSIS OF THE EFFECTS OF PROGRESSIVE
HEAVY RESISTIVE EXERCISE ON THE MOTOR
COORDINATION OF A GROUP OF HIGH SCHOOL
BOYS—AGES FOURTEEN TO EIGHTEEN**

(L. C. Card No. Mic 59-1891)

Sidney Calvin, Ed.D.
University of Maryland, 1958

Supervisor: Doctor Benjamin H. Massey

In recent years research workers have found that repetition of heavy resistive exercises, as is the case in many occupations and in weight training, causes the muscles to grow stronger and to hypertrophy. Even more recent studies have shown that actually this increased hypertrophy of muscles did not reduce the speed of muscular contraction, as was the general belief earlier. It was shown by various workers in the field that actually weight training increased the speed of muscular contraction.

Yet, there are many physical educators who still feel that increased muscular development, especially when very pronounced, tends to make the individual awkward to "muscle bound"; and that this condition hinders one in the performance of refined movements and skills. A question exists as to how progressive resistive exercise affects motor coordination. Therefore, the purpose of this study has been to investigate the effects of a program of progressive resistive exercise in the form of weight training on the motor coordination of high school boys. This investigation resulted in an experimental research project.

An experimental group of twenty subjects trained with weights for four months, three times per week, one hour per session. This one hour session was not actual exercise time but was the time needed to do ten separate exercises as one set, and then complete the same set for a second time. Depending on the individual, a pause of from ten seconds to one minute or two was required between exercises. Additional time was allowed for dressing and showering. During this experimental period a control group of twenty subjects participated in the general physical education activities for approximately the same amount of time in the high school where both groups were students. In order to determine if any changes in motor coordination were accompanied by corresponding changes in the strength and anthropometrical measurement of muscles, a decision was made to record selected strength and anthropometrical measurements in addition to test scores on selected elements of motor coordination on a test-retest basis. All subjects were administered what were considered to be valid and reliable tests of motor coordination immediately prior to and immediately following the experimental period. These tests of coordination were selected to measure speed of movement, accuracy and dexterity, which appear to be the most often mentioned elements of motor coordination.

The entire experiment included five divisions:

- 1) The Pre-experimental Period, during which the researcher practices measurement and testing procedures, and established test reliabilities on practice testing groups.
- 2) The First Testing Phase, during which the anthropometrical and strength measurements were obtained, and

tests of coordination were administered to the experimental and control groups. This phase immediately preceded the experimental period.

- 3) The Experimental Period, during which the experimental group engaged in progressive resistive exercises in the form of weight training, and the control group engaged in a general program of physical education.
- 4) The Second Testing Phase, during which the anthropometrical and strength measurements which were obtained in the First Testing Phase were again obtained, and the tests of coordination were again administered to the experimental and control groups. This phase immediately followed the Experimental Period.
- 5) The Post-experimental Measuring Period, during which the subjects of both groups were again re-measured on all anthropometrical and strength variables. This period followed the Second Testing Phase.

At the conclusion of the experiment, there was a statistical analysis of the measurements and test scores obtained in the First Testing Phase and the measurements and test scores obtained in the Second Testing Phase. In addition, there was a statistical analysis of selected data obtained in the Post-experimental Measuring Period.

As a result of this investigation, it was found that the weight training program did not have deleterious effects on the participants; that there were statistically greater increases in the anthropometrical and strength measurements of the experimental group over the control group; and that the motor coordination of the experimental group improved statistically more significantly than did the motor coordination of the control group.

Microfilm \$2.00; Xerox \$6.60. 136 pages.

**A STUDY OF THE INFORMATIONAL NEEDS OF
COLLEGE WOMEN SPORTS SPECTATORS**

(L. C. Card No. Mic 59-2311)

Vivian Floyd Lewis, Ph.D.
The Ohio State University, 1953

In this age of a preponderance of leisure time in which one finds million dollar stadiums, "big business" athletic programs, amateurism, basketball scandals, Johnny Bright cases, international competition, bowl games, professionalism, and millions of Americans watching sports - some as advocates of sportsmanship and good ethical character, others as sport menaces - there are problems to be faced and values needed. These inevitable factors in our American culture must be recognized by those developing college curricula. Today, educators must study, along with the other problems of our society, the problems of young ladies as sports spectators and be aware of the competencies and understanding young ladies will likely need to cope with the changing world of sports and the values they must live by as they share American sports with the contestants.

Added leisure demands new abilities and understandings on the part of the great group of citizens who spend their leisure hours as spectators. The changing nature of spectator sports also demands a greater diffusion of knowledge and understanding. Within the range of curricula practices

and changes, significant advances have been made, but mingled with these are procedures established to meet the needs of other times. Education has not kept up with leisure time activities, competitive sports, and the surge of watching, although history has shown us that competitive sports and watching as a leisure time activity developed coincidentally and coextensively with civilization itself. The question, What shall be the sources and nature of the college experiences for spectator participation that will promote understanding of and appreciation for sports among college women? necessarily waits for an answer. In order to justify society's faith in education, schools and colleges must build a curriculum which will help young ladies develop the understanding, appreciation, and democratic values needed to fully enjoy our college and professional sports. The living, driving, and vitalizing element of watching the college games should not be entirely crowded out by the tool subjects: reading, writing, arithmetic, and other fundamental or basic subjects which are given along with them. Sports are here to stay and watching or looking on will remain an integral part of them.

Although many educators¹ and institutions have shown that there is a current realization of a need to stress appreciation and understanding of competitive sports in special survey-orientation courses or as a part of the regular physical education program, the writer has found no data on a separate course entitled Sports Appreciation, nor found any studies that clearly reveal what should be taught to women in terms of becoming more appreciative spectators. In recent years there has been an abundance of materials on sportsmanship or how to act at the game. However, little has been written on what to look for in the game, or how to become a real spectator participant. The average women spectator has not been able to see during a game what should be seen in order to attain maximum enjoyment of the sport, nor has she been able to derive the same social, emotional, physical, and ethical values from the game as the contestants or participants. Many books have been written for the technicians, the coach, and the players which are too technical and really afford little aid to the fan because of the technology and terminology used.

Because of the vast impact of watching on American culture and the scarcity of data on what the spectator should look for and derive from the game in order to appreciate and understand it in its entirety, the writer feels that if the fan could be given a fuller realization of the organization of the game its current terminology, its rules, its plays, and the values derived from it by both spectators in sports appreciation, the fan might achieve a greater appreciation of the elements of the contest and enjoy a rewarding experience through fuller understanding.

Today, alert educators are asking these questions: "Can we satisfy what we are doing for our students?" "What do our students feel they need and what do we think they need?" "Why have needs become so important and how can we discover them?" In order for an educational program to be effective or of any real value to the students, it must be basically functional, living, and centered around student needs. Whether consciously planned to be so or not, any investigation into student needs is an attempt to overcome the stigma of traditional courses and methods in which teaching units are simply subject matter suggested by books and presented to students without any consideration of their problems, curiosities, and desire for information. The teacher who comes to know that the

student wants or needs as a spectator may intelligently make a contribution to the student's life in the world of spectator sports.

This study was undertaken in order to discover the needs of college women spectators and to use these found needs as suggested subject matter for teaching units in a sports appreciation course designed to satisfy the curiosities and needs of college women.

Purpose of the Study

The purpose of this study was fourfold: (1) to ascertain what information college women sport fans feel they need to know about spectator sports in order to understand and appreciate them; (2) to ascertain what coaches of these sports think college women need to know about the game in order to be appreciative and understanding spectators; (3) to determine how the data obtained from students and adults could be adjusted, combined, and compiled so as to serve as suggested subject matter for a course in sports appreciation; and (4) to show the extent to which these data can be used intelligently in teaching a class in sports appreciation.

Procedure

In order to discover student needs, an instruction sheet was prepared seeking information about what college women wanted to know about the sports they watched as spectators. Copies of the instructions and three-by-five cards were sent to instructors in the women's division of physical education at twelve Ohio colleges. The teachers gave the instruction sheets and three-by-five cards to women students enrolled in the service class program. These students wrote on the three-by-five cards, using one card for each question, the questions about spectator sports that they needed answers to in order to satisfy their curiosities and needs and improve their understanding and appreciation of amateur and professional sports.

The data received from this phase of the study were tabulated to determine what the informational needs of college women spectators were as indicated by the number of questions asked. The tabulations showed that 2425 women in the 12 selected colleges asked 4348 questions about 20 sports.

On the basis of criteria established, 15 of the 20 sports, about which questions were asked by students, were discarded, leaving five sports - football, baseball, basketball, tennis, track and field - for use in this study.

There were 3415 questions asked about the five selected sports. These questions were tested by means of selected criteria, and as a result were reduced to 292 questions, represented by 61 on football, 87 on baseball, 63 on basketball, 50 on tennis, and 31 on track and field. All other questions were eliminated from the study.

In order to test the cruciality² or importance of the 292 questions, a questionnaire of student questions was prepared for each sport. Sixty copies for each sport were distributed among 300 women enrolled at Central State College, who were asked to judge the importance of each question in terms of its value in improving the women spectator's understanding and appreciation of the game. A "(2)" placed before a question served to indicate that the question was very important; "(1)" indicated that it was important; and "(0)" indicated that it was of little or

no importance. Data received were tabulated in order to determine the extent to which the questions on each sport were important in terms of student judgment and the extent to which the questions could be included as suggested subject matter.

The same questionnaires were sent to ten Ohio coaches of each of the five selected sports; they were asked to serve as expert or adult judges and also to indicate the importance or significance of each question in terms of its value in improving the woman spectators understanding and appreciation of the game. Data received from five coaches of each sport were tabulated in order to determine the importance of student questions from the standpoint of adult opinion.

Other media were used to obtain useful and needed information to include as subject matter in a sports appreciation course. These supplementary sources of data were radio, television, newspapers, magazines, and comments suggested by the coaches who were asked to cooperate in the study. For a period of one year the investigator collected and recorded suggested questions about spectator sports that were suggested through the sources mentioned and considered as important from the standpoint of information for the spectator.

Treatment of Data

The final selection of questions to use as suggested subject matter involved an analysis of data received from the two sources, student judgment and adult judgment.

The procedure of handling data on student judgment was as follows:

1. Every question in each sport was tallied under the number (2), (1), or (0) that represented its degree of importance as felt by each student judge. A total of 60 responses were recorded for each question. This number represented the total number of students previously selected to react to the questions.
2. The frequency of responses for each question under the (2), (1), or (0) area of importance were totaled and tabulated as raw scores.
3. Percentages of responses in each area of importance were computed from the raw scores indicated in step two. These percentages served to indicate the proportions of individuals serving as student judges who considered the questions as (2), (1), or (0) in importance.

A minimum of 60 per cent was selected as the criterion to use in determining the acceptance or rejection of a question. This per cent represented more than one half, which eliminated uncertainty, or the "fifty-fifty proposition," and provided for a noticeable degree of importance. As a result of this procedure, questions with 60 per cent or more responses in the (2) or (1) area of importance were selected as suggested subject matter for the course in terms of student judgment. All questions voted (0) in 60 per cent or more of the cases were discarded from the study.

Data received representing adult or expert judgment were analyzed after the refining of all data on student judgment had been completed. The procedure covered in order to extricate the data on adult judgment was as follows:

1. All questions in each sport were tallied under the number (2), (1), or (0) as indicated by each adult judge or coach. A total of five responses were recorded for each question. This number represented the total number of judges selected to contribute to this study by reacting to the 292 student questions.
2. The frequency of responses under the (2), (1), or (0) area of importance were totaled in order to determine frequencies, and then frequencies were tabulated as raw scores.
3. Percentages of responses in each area of importance were computed from the raw scores found in step two. These percentages indicated the proportion of coaches serving as adult judges who considered the question as (2), (1), or (0) in importance. Since five was selected as the number of replies from coaches to use to substantiate conclusions on adult opinion, the percentages were either 100 per cent, 80 per cent, 60 per cent, or 40 per cent. The chance of exact equality for or against, or the "fifty-fifty proposition," was eliminated, thereby simplifying the opportunity to reach sound or nearly exact conclusions on adult opinion.

Once all the data from the three sources – student felt need, student judgment of the importance of each felt need, and adult judgment of the importance of student felt needs – had been collected, organized, and analyzed, it was easily discernable to the investigator that although student felt needs and student judgment of the importance of each need were established as the primary criteria for selecting subject matter for the course in sports appreciation, correlation and supplementation of these data with adult judgment would provide excellent material for the course of study. Therefore, adult judgment was used as a check on student judgment, not as a criterion for selecting material, but rather to provide objectively a reason to give more consideration to those questions showing a balance in importance in terms of student and adult judgment. All questions ranking 60 per cent or more in the very important area, (2), according to both student and adult or expert judgment were given first consideration and immediately selected as very important subject matter. Questions ranking 60 per cent or more in the important area, (1), according to both students and expert judgment were considered next in importance and also selected as important subject matter. Questions ranking 60 per cent or more in the no importance area, (0), according to both student and adult judgment were eliminated as possible material for the course of study.

Several questions in each sport showed no harmony or agreement in terms of student or adult judgment. In such instances, the writer used student judgment alone as the criterion for selecting or eliminating the question since fulfilling student felt needs is the primary concern of education. For example, the football question, "What signals and timing devices are used by the teams to designate each play and when to begin it?" ranked 71.6 per cent by students in the important area, (1), whereas the five football coaches serving as adult judges ranked the question 60 per cent in the of no importance area, (0), the coaches thus suggesting that this question should be eliminated. However, the 71.6 per cent in the important area, (1), indicated

a high degree of student interest in the question; therefore, it was considered by the writer as a significant student need deserving preference as subject matter. Questions represented by 60 per cent or more responses in the (0) area of no importance according to student judgment were eliminated as possible subject matter.

The data secured in answer to instruction sheets, cards, and questionnaires on student and adult judgment, supplemented by related and vital information secured by other methods and from other sources mentioned were analyzed and organized as discussed and culminated as suggested teaching units for a course in sports appreciation dealing with football, basketball, baseball, tennis, and track and field. The titles of each unit and the order of progress of the information in the units were selected on the basis of student opinions supplemented by the judgment of the writer. The titles of the units were not altered appreciably from the wording in which they were stated by students. The units were organized into four divisions, Points for Discussion, Teaching Suggestions, Required Readings, and Additional References, to serve as sources of references for intended users of the units. The origin of each question in the units is indicated by selected symbols, namely, by CW for college women; WR for the writer; FC for football coaches; BC for baseball coaches; BaC for basketball coaches; T for tennis coaches; and Tr for track coaches.

Unit II on the topic, Appreciating and Understanding Football, is presented as a sample unit.

Appreciating and Understanding Football

Going Into Action

Unit II - Advancing the Ball

Phases Included in Unit:

- Starting the game - Flip of coin; Kick-off
- Line of scrimmage
- Huddle
- Offensive formations
- Defensive formations
- Plays
- Signal system for plays
- Downs

*Identity of origin of question

Points for Discussion:

1. How is the decision made as to which team should kick-off? CW
 - 1.1 Why is a team permitted to kick the ball over at the start of the half? CW
2. Is there a special formation for the kick-off? CW
3. What does line of scrimmage mean? CW
4. What goes on in the huddle? CW
 - 4.1 Who decides what the next play will be? CW
 - 4.2 Is a team always required to huddle? WR
5. What are the various offensive formations in football? CW
 - 5.1 What is T-formation? CW
 - 5.2 What is the single-wing and double-wing formation? CW
 - 5.3 What is split T-formation? CW
 - 5.4 What is spread formation? CW
 - 5.5 What is punt formation? CW

6. What are some of the defensive formations? CW

- 6.1 What does the announcer mean when he says 6-2-2-1, 5-4 and "umbrella" defense? CW
- 6.2 What is 6-3-2 and 7-2-1 defense? CW
- 6.3 What is a "line backer"? CW
- 6.4 What is a "safety man"? CW
- 6.5 What is a "secondary"? CW

7. What are some of the commonly known plays in football? CW

- 7.1 What is a "trap play"? CW
- 7.2 What is a "quarter back sneak"? CW
- 7.3 What is a "statue of liberty" play? CW
- 7.4 What is a "screen" pass? CW
- 7.5 What is a "lateral"? CW
- 7.6 What is a "flanker"? CW
- 7.7 What is a "spinner" play? CW
- 7.8 What is a "quick opener" and "cross buck"? CW
- 7.9 What are "end-around" and "off tackle" plays? CW
- 7.10 What are "reverse" plays? CW

8. What signals and timing devices are used by the teams to designate each play and when to begin it? CW

9. What are some of the terms used to express playing techniques? WR

- 9.1 What is a "decoy"? CW
- 9.2 What is a "fair catch"? CW
- 9.3 What is down field blocking? CW
- 9.4 What is "to the weak side"? CW
- 9.5 What is "stiff arming"? CW

10. What is a down? CW

- 10.1 Why does a team usually kick on the fourth down? CW
- 10.2 What is the purpose of the turn over signs numbered 1 to 4 held by a man at the opposite side of the playing field? CW

11. How do the officials and the players determine when a play is finished? CW

- 11.1 When one player kicks the ball and no one touches it, why do all the players run toward the ball with their arms in the air and yell "don't touch it"? CW

Teaching Suggestions:

Discuss questions in this unit.

Let the students select teams in class and arrange them in the various offensive and defensive formations.

Run a simple play from one of the formations and then let the students decide on the line of scrimmage.

Let one of the offensive teams selected during class time execute a huddle and return to the line of scrimmage for a play; then let a defensive team establish a formation.

Arrange for the class to watch the varsity practice in order to see some of the plays in action and hear some of the signals and timing devices.

Run several simple plays off in class; use huddle, signals and timing devices; then let the class determine yardage and downs.

Request the students to work in groups of two and keep a game chart of a scheduled varsity game - show time game started, who kicked-off, where ball was received, and returned to, downs, and notes on formation used.

Show a short film of a football game.

Required Readings:

Bible, D. X. Championship Football. New York: Prentice-Hall, Inc., 1947, pp. 87-89; 96-129; 163-184; 240-241.

Caldwell, Charles. Modern Football for the Spectator. New York: J. B. Lippincott Company, 1953, pp. 26-41.

Faurot, Don. Football: Secrets of the "Split T-Formation". New York: Prentice-Hall, Inc., 1950, pp. 340-341.

Leahy, Frank. Notre Dame Football - The T-Formation. New York: Prentice-Hall, Inc., 1949, pp. 222-228.

Additional References:

Leahy, Frank. Defensive Football. New York: Prentice-Hall, Inc., 1951, pp. 1-7; 189-193.

Meyer, L. R. Spread Formation Football. New York: Prentice-Hall, Inc., 1952, pp. 15-42.

Munn, C. L. "Signal Systems." Athletic Journal, 30 (June, 1950), p. 9.

*CW - Question obtained from college women.

FC - Question suggested by football coach.

WR - Question suggested by writer.

Conclusions and Recommendations

1. A summary of the literature indicated that although watching while others participate has grown by leaps and bounds, institutions of higher learning have made minor attempts to develop appreciative and understanding women spectators.
2. The 4348 questions indicating student felt needs served to justify the writer's assumption that there is a need for a course in sports appreciation based upon student needs
3. There was close agreement between student judgment and adult judgment on the importance of the questions asked by the college women. This information served to indicate the extent to which students can determine their own needs if given the opportunity.
4. Little supplementary data was needed; therefore, few suggestions from the writer or coaches are found in the teaching units. This showed the inclusiveness of the opinions of students about their needs as spectators.
5. The teaching units in the study are not included because of their perfection, but because they serve to answer these questions: What do students think they need? What do adults think students need?

and, How can student and adult thinking be combined for the purpose of improving educational practices and satisfying student curiosities.

6. The topics and units included in the study are not complete, nor should the reader or user assume that they have settled everything in advance and thereby use them word for word and suggestion for suggestion, but rather the reader should consider the material as a source of reference to search through for ideas to use in planning with students their course in sports appreciation. The user should keep in mind that she is trying to help your students work, think, plan, and evaluate for themselves. You can stimulate students to exert effort on the chosen topics through guidance and presentation of models used in the units of this study. Remember that to appeal to student needs is possible after their needs have been looked into by the teacher. The student does not always come with interests or come knowing his need, but rather he may come with formless ideas and an unawareness of his needs. You as a teacher must stimulate him to respond and question; then he will begin to see his needs and will seek ways of satisfying them.

Microfilm \$2.20; Xerox \$7.60. 165 pages.

1. McCormick, Herbert, J. Enriching the Physical Education Education Service Program in Colleges and Universities. New York: Teachers College, Columbia University, 1942, pp. 29, 40; Sharman, Jackson. Modern Principles of Physical Education. New York: A. S. Barnes and Co., Inc., 1937, p. 88; Dintelman, C. J. "For An Enriched Curriculum," Am. Sch. Bd. J., 121 (Oct. 1950), pp. 36-7; Oberteuffer, Delbert. Physical Education. New York: Harper and Brothers Co., 1951, pp. 235-42; Hughes, W. L. "Orientation in Physical Education," J. Health and Phys. Ed., 5 (Dec. 1935), p. 10; Forsythe, C., and Duncan, R. Administration of Physical Education. New York: Prentice-Hall, Inc., 1951, p. 29; Leibee, Howard. "Sports Survey Course, P.E.M. 60a, Physical Education for Men." University of Michigan, 1950; Rosenberg, John. "An Appreciation Course in Physical Education," Am. Assn. Health Phys. Ed. and Rec. J., 14 (Nov. 1943), p. 499.

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THE EFFECT OF ISOTONIC AND ISOMETRIC MUSCLE CONTRACTION TRAINING ON SPEED, FORCE, AND STRENGTH

(L. C. Card No. Mic 59-2038)

Paul Eugene Meadows, Ph.D.
University of Illinois, 1959

PURPOSE: The purpose of this study was to determine whether significant improvements could be made on speed and force of the offensive football change and static and dynamic strength by two muscle contraction training methods.

METHODOLOGY: Eighty-four members of the freshman and varsity football squads at St. Cloud State College, St. Cloud, Minnesota were used as subjects. All subjects were given initial tests in: (1) speed and force of the offensive football charge; (2) right grip, left grip, back lift, and leg lift strength; (3) chins, dips, and the vertical jump. Strength per pound of body weight was also computed by dividing body weight into total strength. The subjects were then assigned randomly into three groups of 28 subjects each: The Isotonic Group engaged in a 10 week program of weight training three times a week; the Isometric Group participated in a static pull exercise program in varied body positions over the same length of time with the same frequency; the Control Group did not engage in a regularly scheduled training regimen but the majority of the subjects in this group participated in the regular physical education program. At the conclusion of the 10 week training period, all subjects were retested. Analysis of variance was used to compare the results of the three groups and the *t* test was applied to test for significance between pairs of group means and within groups. The Analysis of Covariance was introduced in the statistical analysis to adjust for the inability to match the three groups on the tests of speed and force prior to the experimental treatment.

CONCLUSIONS:

1. Both speed and force showed significant *F* ratios at the one percent level in the comparison between the three groups. The isotonic and control group comparison showed significant differences at the one percent level on speed and force (speed, *t* 3.599; force, *t* 2.854). The isometric and control group comparison was significant at the five percent level (speed, *t* 3.122; force, *t* 2.112). No significant differences appeared between the two experimental groups on these tests. In the within groups comparison, both experimental groups improved significantly at the one percent level.

2. In the isotonic and control group comparison on the strength tests, the following were significant at the one percent level: Chins (*t* 4.128); vertical jump (*t* 4.107); leg lift (*t* 3.298); back lift (*t* 3.004). Dips were significant at the five percent level (*t* 2.238).

3. The isometric and control group comparison revealed the following strength tests were significant: Dips at the five percent level (*t* 2.148), and leg lift at the one percent level (*t* 2.899).

4. Chins were significant at the one percent level (*t* 2.832) and dips at the five percent level (*t* 2.211) in the isotonic and isometric group comparison.

5. The two experimental groups showed significant improvements at the one percent level in the following strength tests: Chins, dips, vertical jump, leg lift, and back lift. Right grip and left grip strength improved at the five percent level for the isotonic group. The control group improved significantly at the one percent level in the vertical jump and back lift strength tests, and chins, right grip, and leg lift showed significant improvements at the five percent level.

6. Strength per pound of body weight revealed no significant differences in the between or within group comparisons.

The general conclusion reached was that the development of strength in the isotonic and isometric muscle contraction training methods had a beneficial effect in improving the performance of speed and force of the offensive football charge. Microfilm \$2.00; Xerox \$6.00. 124 pages.

EDUCATION, PSYCHOLOGY

THE RELATIONSHIP BETWEEN NEED PATTERNS OF STUDENT NURSES AND SATISFACTION WITH NURSING EDUCATION

(L. C. Card No. Mic 59-1780)

Oliva Palafox Carino, Ph.D.
The University of Nebraska, 1959

Advisers: Charles O. Neidt and Gordon H. Henley

This study was undertaken to investigate the relationship between the need patterns of student nurses and their satisfaction with nursing education.

The sample consisted of three hundred twenty-two student nurses selected from all class levels in the nursing education training program of four schools of nursing in Nebraska. To gather the necessary data, two instruments were used. One of them was the Edwards Personal Preference Schedule, a personality inventory designed to measure fifteen relatively independent normal personality variables based upon the concept of need. The second instrument, the Nursing Education Satisfaction Scale, was constructed purposely for this study and was designed to obtain a measure of the attitude of student nurses toward nursing education. These two instruments were administered close to the beginning of the second semester of the school year, 1957-1958. Individual cumulative grades were also collected.

Five hypotheses were tested, namely:

1. A relationship exists between individual needs and satisfaction with nursing education when achievement is held constant.
2. A relationship exists between individual needs and school achievement when satisfaction is held constant.
3. The need pattern of nurses experiencing satisfaction with nursing education is significantly different from the need pattern of nurses not experiencing satisfaction with nursing education.
4. Various programs of nursing education are associated with differing degrees of satisfaction expressed by student nurses.
5. Differences in degree of satisfaction exist among class levels within different schools of nursing.

The statistical techniques used for analyzing the data included the analysis of variance, "F" tests, discriminant function, and the split-half method of correlation corrected with the Spearman-Brown formula.

Ample evidence was obtained to indicate that of the fifteen personality variables, six showed highly significant relationships with satisfaction with nursing education, using cumulative grades as the control measure. The six personality variables are Deference, Exhibition, Autonomy, Nurturance, Endurance and Heterosexuality. Differences in need pattern for student nurses who were not highly satisfied with nursing education from the student nurses who were highly satisfied was obtained. The means of the satisfied student nurses were higher in the personality variables of Deference, Nurturance and Endurance, while the means of the dissatisfied nursing students were higher in Exhibition, Autonomy and Heterosexuality.

To identify the relationship of the fifteen personality

variables and school achievement, the cumulative grades were used as the criterion and the satisfaction scores were held constant. Three personality variables showed highly significant relationships with grades; namely, Achievement, Exhibition and Autonomy.

Ample evidence was also obtained to indicate that differences in degrees of satisfaction existed among class levels within a school of nursing as well as among the four schools of nursing. However, differences in satisfaction were not obtained when considering the curricular program of three-years training or four-years training.

In conclusion, insofar as the present study is concerned, the Edwards Personal Preference Schedule is a useful instrument in determining the personality needs of student nurses. The Nursing Education Satisfaction Scale is a reliable instrument to use in determining the satisfaction of student nurses with nursing education. With the use of these instruments, the differences in need patterns between satisfied student nurses and dissatisfied student nurses was established.

A recommendation for further research along this area is suggested. A study of specific factors which contribute to satisfaction or dissatisfaction with nursing education may prove useful in suggesting improvements in the curriculum and for isolating the areas needing attention by the individual nursing schools involved.

Microfilm \$2.00; Xerox \$6.00. 122 pages.

TEMPORAL ARTICULATION OF BEHAVIOR WITH ENVIRONING PROCESSES: A STUDY OF THE RELATION OF ESTIMATIONS OF TIME TO LEARNED BEHAVIOR AND ORGANIZATIONAL DESIGN IN CONDITIONING

(L. C. Card No. Mic 59-1028)

Jay E. Frank, Ph.D.
New York University, 1958

Chairman: Professor Edward L. Kemp

The Problem

The purpose of this investigation was to determine reciprocity of time estimations and behavior in conditioning. Specifically, the experiment sought to produce symptoms of experimental neurosis in 22 male rats of standard Wistar strain, age 60 to 90 days, by manipulating the subjects' estimations of time.

Method

Subjects were conditioned at a given time interval, to a conditioned stimulus buzz or light of .5 seconds duration, delivered prior to the unconditioned stimulus, a mild electric shock of .25 seconds duration. When the conditioned response was firmly established, the interval between Sc-Su presentations was expanded or contracted to a new setting according to program.

Each animal received from 32 to 47 trials. The trials generally consisted of from 60 to 180 Sc-Su presentations delivered continuously in from three to 120 minutes. Additional variables introduced in the course of the experiment were: 1) Subject's movement unrestricted; 2) subject under severe restraint; 3) light normal; 4) light

blacked out; 5) intervals between presentations randomized; 6) durations of the conditioned stimulus, the unconditioned stimulus, or both, expanded; 7) intervals between the conditioned and unconditioned stimuli expanded; 8) subject conditioned to and during exhaustion; 9) subject conditioned to and during starvation; 10) subject conditioned to different stimuli and with different time intervals programmed for presentation of stimuli to fore and hind paws.

Results

None of the variables introduced in the course of this experiment produced marked behavior change outside the experimental situation. Symptoms obtained did not reach the criteria set for the study, the production of major breakdowns in the organizational design of the subjects approximating the syndrome of audiogenic seizure. The symptoms obtained did, however, compare favorably with those reported in other studies in experimental neurosis.

In the experimental cage, symptoms consisted of: 1) Spontaneous loud squealing, 2) glottal crying, 3) hissing, 4) moaning, 5) urinating, 6) defecating, 7) ejaculating, 8) shivering, 9) gnashing of teeth, 10) sudden jumps, 11) rapid respiration, 12) muscular ties, 13) violent escape attempts, 14) biting of cage, 15) anticipation, 16) stereotyped reversal of position after each presentation, 17) accepting shock lying on back.

Symptoms obtained in the home cage consisted of: 1) sluggishness of movement, accompanied by 2) passivity, failure to move, no avoidance of Experimenter's hand, or 3) hyperactivity and 4) avoidance of Experimenter's hand. In addition, 5) all animals displayed lowered startle threshold, focusing on and flinching to a series of fingersnaps in front of the cages. Flinches could be obtained to 10 snaps consecutively.

Conclusions and Recommendations

1. The criteria for this study never have been accomplished without supersonic sound, with the sole exception of a single animal. The lack of agreement on criteria that would satisfy criticism, and yet be concerned with loss dramatic changes in behavior, is perhaps a chief reason why work in experimental neurosis has not progressed and yielded more fruitful outcomes.

2. Experimental neuroses and behavior aberrations are unique patterns of events, of which some pragmatic identification ultimately should be possible. But if the conditions of such events are imbedded in the total matrix of behavior, no technique exists by which they can be demonstrated, they only can be hypothesized.

3. Successful outcomes might result if the experimental procedures described in this study were continued over a very long period, or if the experiments were repeated, using subjects higher on the phylogenetic scale than the rat.

4. Suggestions are given for further studies on "more molar" and "more molecular" levels of behavior. The possibility also is suggested of similar research with micro-organisms.

A definitive bibliography of studies in experimental neurosis published in the English language is provided.

Microfilm \$2.00; Xerox \$6.00. 123 pages.

AN ANALYSIS OF THE EDUCATIONAL ACTIVITIES OF TALENTED IOWA HIGH SCHOOL GRADUATES

(L. C. Card No. Mic 59-1679)

Wilmut George Fruehling, Ph.D.
State University of Iowa, 1959

Chairman: Professor A. N. Hieronymus

Purpose: The major purpose of this study was to analyze the educational activities of talented Iowa high school graduates. The areas of special concern were college attendance, college preference, factors influencing the selection of the college attended, financial considerations, and scholarships. The high school transcripts of the students were also studied.

Procedure: The sample was selected from the 1956-57 senior classes of the Iowa high schools which participated in the state 1956 Fall Testing Program. A total of 991 students who had composite scores on the Iowa Tests of Educational Development with a percentile rank of 80 or above were selected. In order to make comparisons among different ability groups, a proportional sampling procedure was adopted within the following percentile rank ranges: 99 and above; 95 through 98; 90 through 94; and 80 through 89.

School administrators were requested to supply the addresses of the students, the name of the college attended, if any, and copies of the students' high school transcripts. Addresses and college information were complete for 96 per cent of the initial sample.

Upon receipt of the addresses, questionnaires were mailed to the students. A total of 752 questionnaires (76 per cent of the initial sample) was returned.

Results: 1. In the top 1 per cent, 95 per cent of the questionnaire-returning group had enrolled in a college the year following high school graduation. Approximately 80 per cent of the top 20 per cent report college attendance for this period.

2. Of students in the top 1 per cent attending college 24 per cent leave the state, 53 per cent attend one of the three state-supported institutions, and 23 per cent attend other Iowa colleges. For the top 20 per cent, these estimates are 22, 44, and 34 per cent, respectively.

3. Data indicate that less than one-half of the college-going students are attending an institution of their first or second choice if cost is disregarded.

4. Of those not attending college, 65 per cent of top 1 per cent and 38 per cent of the top 20 per cent plan to enroll at some future time.

5. Lack of funds is the most frequently given reason for not attending college.

6. Of those not in college, 76 per cent of the top 1 per cent and 62 per cent of the top 20 per cent indicate that they would have gone to college if they had been offered the "right kind" of scholarship.

7. The most important factor in the selection of the institution attended is the quality or type of training which the student believes the institution offers. Other factors of importance in the selection of a college are the cost of

attendance and the distance the institution is from home. Scholarships influence about one-fourth of the students in the top 20 per cent in selecting a college to attend.

8. Fifty-seven per cent of the top 1 per cent and 36 per cent of the top 20 per cent received a scholarship.

9. Approximately 15 per cent of the funds that the top 1 per cent needs for the first year of college comes from scholarships. In the top 20 per cent less than 10 per cent of the money comes from scholarships. Parents provide approximately 50 per cent of the funds needed by the top 20 per cent to attend college.

Microfilm \$2.35; Xerox \$8.20. 178 pages.

THE RELATIONSHIPS AMONG TESTS OF INTELLIGENCE, LEARNING, AND REASONING

(L. C. Card No. Mic 59-2235)

Berj Avedis Harootunian, Ph.D.
University of Pennsylvania, 1959

Supervisor: M. W. Tate

Purpose

The major questions with which this study was concerned are:

What are the relationships between intelligence tests and tests of learning?

What are the relationships between intelligence tests and tests of reasoning?

What are the relationships between tests of learning and tests of reasoning?

It was of interest also to consider a related question: What differences are there in the power of tests of intelligence, learning, and reasoning to predict school achievement?

Procedure

The performance of eighth-grade pupils on tests of intelligence, learning, and reasoning was studied to determine the relationships among these abilities. A total of 105 subjects were administered one or more tests, and 88 pupils, 48 boys and 40 girls, were present for all of the tests administered specifically for this study.

The intelligence tests used are the Otis Beta, Form Cm, and the California Test of Mental Maturity, 1951 Edition, Long Form. The learning tests comprise Nonsense Syllables, Number Maze, Gates Associative Learning, Modified Associative Learning, Digit-Symbols, Mirror Reading, Cards, and Mirror Drawing. Three reasoning tests were given: the Davis-Eells Games, Number Series, and the Maw Critical Thinking. In addition, four achievement measures were available from the school files: the three tests making up the California Achievement Battery and the average of the final marks in eighth-grade English, social studies, mathematics, and science.

Findings

The intercorrelations of the single tests of intelligence, learning, and reasoning showed that the relationships vary considerably, and depending upon the pairs of tests correlated, a number of different conclusions could be made

regarding the relationships among these abilities. The coefficients of correlation between the intelligence and learning tests ranged from .14 to .65; between the intelligence and reasoning tests, .43 to .63; and between the learning and reasoning tests, .06 to .58. It was shown through regression theory that in every instance variables other than those considered accounted for more than half of the variance. Intelligence, learning, and reasoning, as measured by the single tests, cannot be considered as identical abilities.

The learning and reasoning tests were combined into respective composite tests. The coefficients of correlation between the tests of intelligence and Composite Learning ranged from .56 to .73; between Composite Learning and the separate reasoning tests, .42 to .74; between Composite Reasoning and the intelligence tests, .68 to .76; and between Composite Reasoning and Composite Learning the coefficient was .69. These results give considerable support to the hypothesis that a pool consisting of a large number of learning measures would correlate as highly with intelligence tests as intelligence tests do with each other. This does not mean that the abilities in question are the same. The most that could be concluded from the data of this study was that tests of intelligence, Composite Learning, and Composite Reasoning elicit abilities which have some common elements. The differences among these tests were also brought out through partial and multiple correlation and regression.

With respect to the prediction of scholastic achievement, the greatest difference among the tests was in their power to predict reading achievement; the results of this study show that intelligence tests elicit considerably more of the elements involved in reading than the composite tests of learning and reasoning. With respect to performance in school subjects, Composite Learning and Composite Reasoning can predict average school marks with at least the same power as intelligence tests. It was proposed that tests of learning and reasoning might add to tests of intelligence in predicting school achievement.

Microfilm \$2.45; Xerox \$8.60. 188 pages.

THE EFFECT OF SUPPLEMENTARY PHONICS INSTRUCTION ON THE READING AND SPELLING ABILITY OF SECOND, FOURTH, AND SIXTH GRADERS

(L. C. Card No. Mic 59-2355)

Frederick William Ibeling, Ph.D.
University of Minnesota, 1959

The purpose of this study was to measure the effect which the use of supplementary phonics workbooks would have on the reading and spelling ability of children at the second, fourth, and sixth grade levels. The experiment was carried on for about six months, from the end of October to the end of May, in the public schools of Wayzata, Minnesota. In the experimental classrooms, instruction using popular phonics workbooks was made part of the reading program; in the control classrooms, these phonics workbooks were not used. The pupils were tested at the beginning and end of the experimental period with standardized tests of reading vocabulary and comprehension,

spelling, visual analysis, and phonetic knowledge. Tests used were the Gates Primary and Advanced Primary Reading Tests in the second grade, the California Elementary Reading Test in the fourth and sixth grade, and Progressive Spelling Test in all grades, and the Bond Diagnostic Reading Test in all grades.

The pupils in these grades had been assigned to their classes randomly at the beginning of the school year. The classes at each grade level were assigned to either the experimental or the control group by random methods. An attempt was made to give the same amount of supervisory help to both groups during the experimental period. An attempt was also made to equalize the total time spent on reading instruction by the two groups.

Initial and final test results of the experimental and control group at each grade level were analyzed by covariance techniques, which test the significance of obtained differences in means on the final tests and which also make allowance for initial differences between the groups. In this analysis, two highly significant differences and two slightly significant differences favored the experimental group; however, three of these four differences were obtained on the tests of visual analysis and phonetic knowledge. In spelling, one highly significant difference favored the experimental groups at the second grade level. In reading comprehension, one slightly significant difference favored the control group at the fourth grade level.

Test results of pupils of high and low I.Q. were also analyzed separately to determine whether there was any significant interaction between the method of instruction and high and low mental ability at any grade level. There appeared to be such an interaction in the results of the spelling tests at the sixth grade level, with the pupils of low I.Q. showing more progress in the experimental group, and the pupils of high I.Q. showing more progress in the control group. However, there was some question about the validity of the final test scores here.

At the second grade level, the use of supplementary phonics workbooks did increase the visual analysis skills, the phonetic knowledge, and the spelling ability significantly, but it did not produce a significant increase in reading ability. At the fourth and sixth grade levels, the use of phonics workbooks did not produce a significant increase in any area.

The results of this experiment indicate that the use of phonics workbooks add little to the effectiveness of reading instruction when teachers make good use of the workbooks and teachers' guides of a good basic reading series.

Microfilm \$2.55; Xerox \$8.80. 195 pages.

THE RELATIONSHIP OF SELF-CONCEPT TO ACHIEVEMENT IN READING

(L. C. Card No. Mic 59-1853)

Donavon D. Lumpkin, Ed.D.
University of Southern California, 1959

Chairman: Professor L. P. Thorpe

The purpose of this study was to examine the relationships that might obtain between the self-concepts of a group of elementary school children and their achievement in

reading. Fifty pupils in grade five in the Monterey County schools were selected for intensive study; twenty-four over-achievers in reading and twenty-five underachievers were matched on the basis of chronological age, mental age, sex, and home background. These two groups represented the extremes of pupils distributed among a continuum of the extent of achievement above or below expectancy.

Comparisons were made on the basis of responses to a variety of psychological instruments designed to explore dimensions of self-concept, teacher perception of the child, and peer status. Statistical analyses were made and the findings coupled with case profiles of children in each achievement group. The total presentation was designed to provide a comprehensive picture of the quantitative and qualitative differences found to exist between the two groups.

Findings. This study indicated the existence of a variety of significant relationships between pupils' self-concepts, as revealed in an analysis of the data secured, and achievement in reading. Overachievers in reading demonstrated superior performance to a degree statistically significant beyond the 1 per cent level of confidence on a variety of measures, including accuracy in oral reading, vocabulary, and comprehension. Significantly higher achievement was noted in arithmetic, language, and work-study skills, but not to the same degree as that observed in reading. As measured by the instruments employed, overachievers revealed significantly more positive self-concepts, revealed higher levels of adjustment, and saw themselves as liking reading. These children were viewed positively by both teachers and peers.

Underachievers in reading made significantly lower scores on measures of academic achievement. They manifested a predominantly negative perception of self, a desire to be different from the self as seen, and, to a statistically significant extent, they expressed feelings of conflict more frequently. They were viewed by teachers as manifesting high problem tendency.

Conclusions. It is evident from these findings that, in the population studied and in relation to the instruments used, an overachiever in reading is viewed positively by himself, his teachers, and his peers. This outcome confirms current opinion that achievement stems from intrinsic motivation, as well as from the environmental responses to this achievement.

Performance of the underachievers in reading on the instruments utilized shows that the life experiences of these children have contributed to negative feelings concerning themselves and their world which are manifested in lack of achievement. It can be stated with confidence that in the group studied the concept of self which the individual accepts influences his behavior qualitatively and may determine the direction and degree of his expression in academic work as well as in his social relationships.

Recommendations. On the basis of the above findings and conclusions, the following recommendations are offered for consideration and possible exploration: (1) That research based on intensive case study approach be made which would explore all phases of the child's development within his particular social milieu, utilizing all available techniques for determining self-concept factors which contribute to the adjustment or lack of adjustment of children, and designed to ascertain methods for assisting them in making a better adjustment. (2) That research be conducted at early childhood levels which is designed to identify relationships so that attempts can be made to reverse

negative aspects of adjustment and implemented positive ones. (3) That school practices included provision of reading materials with content which has meaning for children as determined through study of the child, his environment, and his self-perceptions. (4) That practices be engaged in which provide increased understanding of the child who expresses aggressive, withdrawing, and nonachieving behavior as a result of his concept of himself.

Microfilm \$5.55; Xerox \$19.60. 436 pages.

THE EFFECT OF WRITING ON THE LEARNING AND RETENTION OF SIGHT WORDS

(L. C. Card No. Mic 59-2041)

Queenie Beatrice Mills, Ed.D.
University of Illinois, 1959

This study attempted to answer the following question: Will the writing (copying) of a sight word facilitate initial learning and aid retention when this procedure is used to supplement the sight method of word presentation in the case of first grade children with average reading ability? The problem was to compare experimentally the relative efficacy of a "look, say, and write" method of teaching sight words with the conventional "look and say" method.

The subjects were 14 children, 8 boys and 6 girls, who had just completed first grade in Champaign-Urbana, a university community in Central Illinois. They ranged in CA from 6-8 to 7-7, in MA from 6-6 to 9-1, and in IQ from 94 to 126. Each had been rated as an "average reader" by his first grade teacher, and the grade equivalent scores in word recognition on the Primary I Battery of the Metropolitan Achievement Tests ranged from 1.8 to 2.4.

The materials learned were 100 commonly known four-letter root words, written in lower-case manuscript with India ink on three-by-five inch cards. Seven of the subjects learned a set of five words one day by the "look, say, and write" method and another set of five words by the "look and say" method on alternate days. The other seven subjects learned the same words on the same days, but the presentation methods were reversed.

A comparison was made of the efficacy of the two methods in terms of the following: (1) the mean number of trials required to learn a set of five words to two perfect repetitions in succession; (2) the mean number of words recalled twenty-four hours after initial learning; (3) the mean number of trials required to relearn twenty-four hours after initial learning; (4) the mean percentage of savings in relearning; (5) the mean number of words recognized one week after initial learning; and (6) the set-mean number of words recognized on a terminal test of the 100 words taught during the five weeks of the experiment.

When the results for the total groups were examined, it was found that more trials were required to learn sight words when "look, say, and write" presentations were used than when "look and say" presentations were used alone. The mean difference was nearly significant at the .05 level. No significant differences were found in terms of twenty-four hour recall, relearning trials, percentage of savings in relearning, or terminal recall; and no observed difference in one week recall.

When the results were examined for the subjects as

individuals, great variability was found to exist. Some subjects were helped, some not helped, and some hindered in learning and/or retention by the addition of the writing factor.

It was concluded that as a group first grade children with average reading ability and legible manuscript handwriting learn sight words with significantly greater facility when a conventional sight method of presentation is used alone than when these children are required to copy the words as an added step in the "look and say" presentation. It would also appear that for these children as a group, writing used to supplement the visual-auditory stimuli provided by the "look and say" presentations has little or no effect on the retention of sight words.

It was also concluded that as individuals, first grade children with average reading ability and legible manuscript handwriting appear to differ from one another with respect to the effect the copying of a sight word has upon learning efficiency and retention when this task is required as an added step in the "look and say" presentation.

Microfilm \$2.00; Xerox \$4.80. 94 pages.

THE INFLUENCE OF SELECTED CULTURAL FACTORS ON HETEROSEXUAL ATTITUDES OF COLLEGE FRESHMEN

(L. C. Card No. Mic 59-1883)

Lars P. Peterson, Ed.D.

The University of Nebraska Teachers College, 1959

Adviser: Professor Charles O. Neidt

PLAN AND PROCEDURE

The basic purpose of this investigation was to determine the relative influence of eleven selected cultural factors on existing attitudes toward heterosexual relationships of individuals during middle adolescence. In order to evaluate the influence of these selected cultural factors, it was necessary to develop a scale to measure attitude toward Heterosexual Relationships. In addition to attitude toward Heterosexual Relationships, measurement was made of attitude toward Self and toward Other.

In the development of the attitude scale, a definition was made of each area from which the statements were developed. From the original 205 statements, 100 were retained through item analysis to be included in the final scale.

In addition to the attitude scale which was developed, a questionnaire was constructed which assessed the following factors: Premarital-marital status, Father's and Mother's occupation and education, Parents marital state, Number of siblings, Home residence and population, Religious affiliation and church attendance, Source of self-information, and closest confidant.

The sample used consisted of 668 freshmen students enrolled at State College, St. Cloud, Minnesota. Of these students, 344 were males and 324 were females. In addition to the college sample, a group of 42 males were taken from the Youth Conservation Commission Reception Center, Minnesota State Reformatory, as a criterion group for validation purposes.

In the development of the attitude scale, the following techniques were used as a means of evaluation: analysis of homogeneity, Spearman-Brown formula for reliability, subscale intercorrelation, and tests of significance between the scores obtained by the various subgroups.

In the differential analysis of the cultural factors, the analysis of variance technique was used to determine similarities and differences which existed between groups on the basis of the questionnaire responses. In addition, the test for the significance of the gap between adjacent means was employed for the purpose of identifying the particular groups which were significantly different.

FINDINGS

The three subscales of the Personal Relationships were found to be non-homogeneous.

The computed intercorrelations ranged from .563 to .730 and were all significant at the .01 level of confidence.

The Spearman-Brown odd-even reliability coefficients ranged from .7958 to .933 with greater uniformity for the college group than for the reformatory group.

In determining the validity of the scale, the tests of significance computed between the college group and the reformatory group yielded significance only in attitude toward Other.

The t-values obtained in the test of significance between males and females of the college sample yielded significance in relation to subscales Other and Heterosexual Relationships.

Of the sixty-six analyses of variance computed, only six yielded significant F-values. Those F-values found to be significant were in the following areas: score on Heterosexual Relationships subscale and premarital status for both males and females; rural-urban classification and subscale Other for females; source of self-information and subscale Other for females; closest confidant and subscale Other for females; and closest confidant and subscale Self for females.

CONCLUSIONS

The general conclusions formulated on the basis of the findings obtained in this investigation are as follows:

Intercorrelations between the three subscales yielded significant correlation coefficients, indicating that there is a significant relationship existing between the attitudes which an individual has in one area to the other two areas.

Males differ significantly from females in their attitude toward others and toward Heterosexual Relationships, but not in attitude toward Self.

Individuals who have no relationships with the opposite sex seem to have different attitudes toward Heterosexual Relationships than those who have relationships with the opposite sex.

Cultural factors seem to play a more important role in the attitudes held by females toward others than they do for males.

Institutionalized males have significantly different attitudes toward others than college students of the sample used.

Microfilm \$2.15; Xerox \$7.60. 163 pages.

RACIAL AWARENESS AND SOCIAL BEHAVIOR IN AN INTERRACIAL FOUR-YEAR-OLD GROUP

(L. C. Card No. Mic 59-2535)

Alice Mendham Powell, Ed.D.
University of Maryland, 1958

Supervisor: Professor Hugh V. Perkins

Purpose

This study was undertaken to investigate whether or not social learning in regard to race at the incipient stage of attitude formation would affect children's behavior in an interracial peer group. The main problem was the relationship between racial awareness and social interaction in a preschool group of Negro and white four-year-old children in a segregated community.

Procedure

Racial awareness was measured by a series of four tests which included three aspects of social learning: the ability to make correct racial self-identification, to identify others, and to identify the family belonging to one racial group. The instruments consisted of identification of "colored" and "white" dolls, of puzzles depicting a family of each race, an interview technique, and a miniature playground with dolls used in a tape-recorded free play session. Fifteen boys and girls comprised the research group, and three tests were administered to an additional group of eighteen four-year-olds from the same preschool for a validity and reliability study.

Social behavior was investigated by three observational methods during the school year. Behavioral differences in the assimilation into the group of new entrants of both races was measured by a comparative analysis of cross-racial interaction, of the amount of negative behavior, and of the racial choice of playmates. Racial awareness in the subjects was compared with cross-racial behavior and friendships between the children of both races. A study of the social structure of the group was made by comparing sociometric choices with observed friendships.

Findings

The series of tests developed to identify and measure racial awareness was found to have adequate validity and reliability.

An understanding of the social meaning of racial differences was found in the research group.

A marked preference for white group membership was shown by Negro children.

No significant relationship was found between racial awareness and intelligence in the research group.

There were no significant racial differences in the assimilation of new children into the group.

Although there were differences between individuals in the relative amounts of cross-racial negative behavior, no significant relationship was found between racial awareness and social behavior in the group.

Racial awareness was found to be an inconstant function at the four-year-old level, although children of high awareness manifested consistency between test performance and social behavior.

Implications of this research for early clarification and acceptance of racial group differences at the preschool level are discussed.

Microfilm \$2.15; Xerox \$7.60. 163 pages.

A GUIDE FOR EVALUATION OF STUDENT CHARACTERISTICS

(L. C. Card No. Mic 59-1884)

Emily Ann Reuwsaat, Ed.D.
The University of Nebraska Teachers College, 1959

Advisers: Warren R. Baller, Ph.D.

Howard E. Tempero, Ph.D.

It was the purpose of this study to develop an instrument for use by the faculty of a teacher-education institution, specifically the Teachers College, University of Nebraska, in evaluation of personal characteristics and self-development of teacher-education students. It would be used to facilitate the implementation of that phase of the selective admission and retention procedures of the College. The plan for accomplishing this was presented to the Teachers College Faculty and their approval and cooperation obtained early in the second semester of 1957-1958.

An adaptation of the critical incident technique was used. Selected faculty members reported descriptions of specific incidents of student behavior reflecting highly desirable or least desirable personal characteristics of teacher-education students. The critical incidents were analyzed to yield brief phrases descriptive of the behaviors. These were sorted and classified into seven categories: Classroom Behavior, Work Habits, Emotional Maturity, Relationships with Instructor and Faculty, Relationships with Peers, Attitude toward Teaching, and General Characteristics.

The phrases were edited and a trial form of the Guide for Evaluation of Personal Characteristics of Teacher-Education Students was constructed, containing two hundred items. Another group of instructors was asked each to mark Guides for six students; half of the instructors were to mark the Guides for students having most desirable personal characteristics, and half to mark Guides for students having least desirable personal characteristics. As no instructor could select six students in the "least" classification, additional instructors marked such Guides. After elimination of duplicates, each group contained forty-five cases.

Chi square analysis showed one hundred seventy-six items to be highly discriminative between the better and the poorer students.

The final Guide was comprised of one hundred carefully edited items with the highest chi square values, keeping the categories roughly proportionate to the number in the trial form. Items were to be marked as "True" or "False" of the student.

At the end of the spring semester, 1958, a total of 737 Guides were marked by twenty-four instructors for 682 different undergraduate students in thirty-one Teachers College professional education classes.

Content validity was considered to be inherent in the method of item construction. Construct validity and reliability were expressed by the coefficient of correlation of inter-rater agreement, computed from the scores of students for whom multiple Guides were marked. The correlation coefficient, .695, was significant beyond the one per cent level of confidence.

The scores of the 46 seniors were not found significantly different from the combined scores of the 337 freshmen, 155 sophomores, and 144 juniors. Scores for all 682

students were pooled to provide percentile norms, for total and for subtotal scores. A profile sheet was devised using an adaptation of percentile norms; five groups were established containing respectively the lowest ten, the next twenty, the middle forty, the next twenty, and the top ten per cent of cases.

A brief manual was written, containing purposes and description of the Guide, information on reliability, validity, standardization, norms, administration, and preparation of profiles, and suggestions for their use by advisors and counselors. Microfilm \$2.00; Xerox \$7.20. 151 pages.

AN INVESTIGATION OF THE DIRECT STUDY OF A CHILD ON THE CHANGES STUDENT TEACHERS REVEAL IN THEIR ATTITUDES, BELIEFS AND UNDERSTANDINGS OF HUMAN BEHAVIOR

(L. C. Card No. Mic 59-2536)

Minnie Loretta Roseberry, Ed.D.
University of Maryland, 1958

Supervisor: Dr. Hugh V. Perkins

Purpose

The purpose of this investigation is to determine the influence of the direct study of a child on changes student teachers reveal in their attitudes, beliefs and understandings of human behavior.

Procedure

The sample for this study consisted of thirty six student teachers enrolled in a southwestern state college. The thirty six comprised the total student teacher population at the time of the study. All were graduating seniors with one exception. Twenty five of the students come from high schools of the state, eleven are out of state. Six of the students are second generation Mexican and Spanish in background. Twenty of the group are married and fifteen have children. The age ranges from twenty to fifty, and of the group seven would approximate the average age for graduation.

The thirty six student teachers were formed into parallel groups through use of the A C E college entrance examination. There was no significant difference in age, sex and level of teaching between the two groups. After the division one group was designated as the experimental and the other the control group. For the control group the usual procedure of student teacher problem discussion was employed and for the experimental group the direct study of a child was the major factor.

The data for the study was secured through a series of paper and pencil tests administered before and after the student teaching experience. These were: 1) The Mickey Murphy Case record which related to Hypotheses I, II, and III and measured the ability of the student to withhold judgment to test hypotheses of behavior and to suggest procedures for a child's adjustment. 2) The Minnesota Teacher Attitude Inventory is related to Hypothesis IV and measures the attitudes of teachers toward children and teaching. 3) The Q Sort is related to Hypothesis V and measures the ability of the student teacher to ascribe qualities of an ideal teacher in terms of her understanding of human behavior.

4) An analysis of the anecdotal records related to Hypothesis VI and measured the ability of the student teacher to increase the number of objective recordings as information was collected about a child.

Findings

1. Both groups of student teachers made significant changes in ability to withhold judgment of children until sufficient evidence has been collected.
2. The experimental group made significant change in ability to test hypotheses of behavior, but this change was not apparent in the student problem discussion group.
3. Both groups changed significantly in ability to suggest procedures for facilitating a child's adjustment.
4. The experimental group made significant changes toward greater acceptance in attitudes toward children and teachers while the control group did not reveal any changes.
5. The experimental group revealed changes in ability to ascribe the qualities of an ideal teacher while the control group registered little or no change.
6. The experimental group made significant changes during the second semester compared with the first semester in ability to record information objectively.

Microfilm \$2.00; Xerox \$5.00. 98 pages.

THE CONSTRUCTION AND VALIDATION OF AN INSTRUMENT FOR THE MEASUREMENT OF READING EXPECTANCY OF ADVANCED PRIMARY AND INTERMEDIATE GRADE PUPILS

(L. C. Card No. Mic 59-2372)

Clayton LeRoy Stunkard, Ph.D.
University of Minnesota, 1959

In the present study a group-administered test was constructed for the measurement of reading expectancy at the advanced primary and intermediate grade levels of the elementary school. The test constructed for this purpose is composed of 105 analogy-type items which require no reading on the part of the test taker. Thirty-five items form each of three parts of the Educational Expectancy Test: Part I--Picture Analogies; Part 2--Symbol Analogies; and Part 3--Directional Symbol Analogies.

The significance of this study lies primarily in its approach to measurement of potential level for performance in the basic skill of reading. Typically, tests used for this purpose have not specifically selected items because of demonstrated relationships to reading ability. Items have most often been chosen because of their relationship to individual measures of intelligence or to total scores of an initial form of the test. Therefore, it is not surprising that such tests prove inadequate for the measurement of reading expectancy.

The Educational Expectancy Test was first administered to 205 pupils in grades 3, 4, 5 and 6 of an elementary school

in a suburb of Minneapolis, Minnesota. Item selection procedures were carried out on this group of pupils. Basically, this process was one of selecting those items with positive relationships to average reading grade on the Gates Reading Survey before and after removing the effect of intellectual ability as measured by the Stanford-Binet.

Sixty-five items were selected as appropriate for use in a validation study. The median item-reading grade biserial correlation coefficient of these items was +.32, and the median percentage of correct responses was 56.6 per cent.

In order to provide evidence of concurrent statistical validity, the Educational Expectancy Test was given to 87 fourth grade pupils in an elementary school in a suburb of St. Paul, Minnesota. These subjects had previously been given the following series of achievement and aptitude tests: Stanford-Binet, Form L, Intelligence Test; the Lorge-Thorndike Intelligence Test--Nonverbal Form A, Level 3; the Iowa Test of Basic Skills, Form 2; Gates Reading Survey, Form I; Davis-Eells Games, Elementary Form; Science Research Associates Primary Mental Abilities, Elementary Form AH; and the Non-Language sections of the California Test of Mental Maturity, Elementary Form.

Separate correlation matrices were formed for the 44 boys and 43 girls of the validation sample. The two sexes were contrasted on a total of 25 measures consisting of subtest and total scores of the above-mentioned tests, and chronological age. They were compared for homogeneity of variances, differences in mean performances and of zero orders correlation coefficients between pairs of measures.

Two major conclusions appear almost self-evident from examination of the findings; they are:

1. The performance of the Educational Expectancy Test was such that further study and revision should be undertaken before this test may be said to be ready for the purpose intended.

2. The differential manner in which many of the measures employed in the validation phase interrelated, when the sexes were contrasted, calls for re-examination of standardization procedures which combine boys and girls.

Differential relationships between the sexes of the various measures with each other seem to imply that the underlying factors of achievement and ability measured by these tests are not the same in each sex.

The Educational Expectancy Test appears to be fairly adequate for the prediction of reading ability as presently defined if used with girls only. However, either it or the criterion, or both, measure different basic factors in each of the two sexes.

Microfilm \$2.65; Xerox \$9.20. 202 pages.

RELATIONSHIP OF VALUES TO LEADERSHIP, SCHOLARSHIP, AND VOCATIONAL CHOICE

(L. C. Card No. Mic 59-1885)

Lawrence E. Vaughan, Ed.D.

The University of Nebraska Teachers College, 1959

Adviser: Warren R. Baller, Ph.D.

The purpose of this study was to investigate the personal values of a class of high school students in order to

determine the relationship between values and leadership, values and scholarship, and values and vocational choice. Two additional aspects of the investigation were (1) to determine the relationship between value areas of the Poe Inventory of Values and interest areas of the Kuder Preference Record - Vocational and (2) to determine what changes take place in values and interests from the sophomore year to the senior year in high school.

Procedure

Values, for this study, were interpreted to be those which Poe's Inventory of Values was designed to measure. Since the inventory had been standardized on groups of college seniors, the writer made a High School Glossary to accompany the inventory when it was administered to high school students.

The participants in this study (180 students as sophomores and 155 students as seniors) were members of the Class of 1958 at Lincoln Southeast High School. The Inventory of Values and the Kuder Preference Record - Vocational were administered twice to this class: once during the sophomore year and once during the senior year of high school. The different variables being investigated in this study called for different sample populations within the total number of students tested. Also, these variables required various statistical treatments of the data collected.

Findings

Three null hypotheses were tested. First, it was hypothesized that there is no significant difference between the value area scores of high school student leaders and the value area scores of those students not elected or appointed to positions of leadership in school activities. This null hypothesis was rejected. The results showed that the difference in the mean Power value scores for student "Leaders" and "Non-Leaders" in the sample population was significant at better than the 1% level.

The second hypothesis was that an Inventory of Values area score does not make any significant contribution toward predicting grade average when the Henmon-Nelson IQ is held constant. The second null hypothesis was rejected. Four value area scores were significant in the prediction of grade averages: Aesthetic, Material, Humanitarian, and Religious.

The third hypothesis was that there is no significant difference between value area scores (on the PIV) of high school seniors interested in the following vocational fields: Business, Engineering, Medicine, Teaching, "I Don't Know." The third null hypothesis was rejected. Five value areas do show significant differences between at least two of the five vocational fields listed. These areas are as follows: Intellectual, Material, Social Contact, Religious, Humanitarian.

The two additional aspects of the investigation revealed respectively (1) that each of the eight value areas on the Poe Inventory of Values correlates significantly with at least one of the ten interest areas of the Kuder Preference Record - Vocational and (2) that values do change in high school--some quite significantly--but not in accordance with any set pattern.

Analysis on the results suggest the following conclusions:

1. Poe's Inventory of Values, with an appropriate

glossary, may be used in high school as a value measuring instrument.

2. Power value is related to leadership in school activities.

3. Value scores, as well as the IQ, are related to scholarship as demonstrated by school marks.

4. Poe's Inventory of Values may be used in vocational counseling and as a screening device in colleges' teacher training programs.

5. Value scores (on the PIV) of high school students decline from the sophomore to the senior year.

Microfilm \$2.50; Xerox \$8.60. 189 pages.

SELF-ESTIMATES OF APTITUDES AND PREFERENCES AND TEST-SCORE DEFENSIVENESS

(L. C. Card No. Mic 59-2500)

Shelby Lewis Walch, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Royal B. Embree, Jr.

The purpose of the investigation was to determine the effects of certain factors upon self-estimates of aptitudes and preferences and upon test-score defensiveness. The factors considered were: sex of the subject, social class status of the subject, and estimating period. Two factors were considered under the heading of estimating period: the experience of taking an aptitude test battery and a preference inventory, and the experience of receiving an interpretation by a counselor of the test scores.

Defensiveness about test scores was measured by means of a test-score defensiveness scale developed by the investigator. Social class status was determined by means of the Index of Value Orientations. The self-estimates were made on a nine-point scale developed by the investigator. The subjects, eleventh grade male and female students were given the Differential Aptitude Tests and the Kuder Preference Record, Vocational. Group and individual interpretations of the test scores were given to the subjects by a team of counselors. The subjects made self-estimates of their standing compared to students of the same sex and school grade for each of the eight aptitudes covered by the DAT and for each of the ten preference areas covered by the Kuder. The estimates were made before taking the tests, after taking the tests, and after receiving an interpretation of the test scores. At the time the estimates were made the subjects indicated their defensiveness about test scores for each of the aptitudes and preferences on a four-point scale. A control group made the self-estimates and filled out the defensiveness scale at two different times, but did not take the tests. Analysis of variance was employed to determine the significance of mean differences in self-estimates and defensiveness due to each of the factors.

Significant sex differences were found for self-estimates and defensiveness for many of the aptitudes and preferences for both the experimental and control groups. Similar results were obtained for social class differences. The experiences of taking the tests and of receiving an interpretation of the test scores were found to have little or no effect upon self-estimates and defensiveness. Self-estimates tended to be more closely related to sex role and

social role expectations than to actual test scores. In general, the subjects exhibited little defensiveness about test scores. Self-estimates of preferences and defensiveness about preference scores were more subject to the effects of the factors than were aptitude estimates and defensiveness. Microfilm \$2.00; Xerox \$6.60. 137 pages.

EDUCATION, TEACHER TRAINING

A STUDY OF COLLEGE AND UNIVERSITY READING CLINICS SERVING ELEMENTARY AND SECONDARY SCHOOL PUPILS

(L. C. Card No. Mic 59-2522)

Olin L. Adams, Jr., Ed.D.
University of Maryland, 1958

Supervisor: Professor Alvin W. Schindler

Purpose

This investigation was undertaken to gather and organize information on college and university reading clinics serving elementary and secondary school pupils and to formulate recommendations for colleges and universities interested in establishing reading laboratories to serve elementary and secondary school pupils.

Procedures

1. Preliminary visits were made to reading clinics in the area of the University of Maryland.
2. A nation-wide survey of teacher-preparing institutions was conducted to establish the locations of reading clinics.
3. Visitation of six recognized reading clinics was completed to study procedures and practices.
4. Information similar to that secured by visitation was solicited by mail from four clinics where visitation was not feasible.
5. Some practices considered desirable were implemented by the writer in his activities at the reading center of the University of Maryland and in his work as a supervisor of elementary education in the public schools.
6. General recommendations were formulated for a university reading laboratory based upon observations from the nation-wide survey and special study of the ten reading clinics.

Findings

Nation-wide Survey. In the spring of 1954 a nation-wide survey of 926 teacher-training institutions was conducted; 670 institutions returned the questionnaires and revealed that 141 college and university reading clinics serving elementary and secondary school pupils were in operation. From these a directory of the agencies was developed.

Specified briefly, the aims of the clinics were (1) to provide diagnostic services, (2) to provide remedial instruction, (3) to assist in the training of teachers and specialists, (4) to assist parents and/or teachers with the reading problems of their children, (5) to provide consultant services for schools, and (6) to promote research in reading.

Twenty-four centers were operated as "one-man" clinics, and eighty centers were staffed by less than five people. The largest clinic was manned by 24 assistants and its director. California ranked first in the number of clinics maintained, Pennsylvania second, and New York third; seven states did not report a clinic. The departments of education and psychology were responsible for the operation of most of the reading clinics, ninety in number.

Elementary school children received the greater assistance at the centers during the 1952-53 school year. At eighty-eight clinics training and laboratory experiences for teachers and specialists were provided. Less than one-half of the 141 clinics sponsored any formal research.

Study of Ten Reading Clinics. With the exception of one, all of the clinics were headed by directors holding the doctoral degree. College students were used at the ten centers although seven required that these students be graduates before assuming actual casework. Half of the centers were self-supporting and the other five received from 25 per cent to 100 per cent of their support from the present institution.

Considerable variation existed in the case-study forms of the clinics, the quantity of equipment which they owned, and the extent to which their personnel were engaged in formal research. Screening techniques for vision, hearing, intellectual capacity, and reading achievement were very similar from center to center.

All ten clinics conducted some program of remedial instruction and teacher-developed materials, along with basal textbooks, were pointed out as the more desirable instructional approaches.

Eight clinics used referral as their disposition for handling clients with strong emotional problems.

Microfilm \$3.05; Xerox \$10.60. 236 pages.

AN ANALYSIS OF PROFESSIONAL LABORATORY EXPERIENCES PROVIDED PRIOR TO STUDENT TEACHING FOR STUDENTS PREPARING TO BE SECONDARY SCHOOL TEACHERS

(L. C. Card No. Mic 59-1881)

Merlin Levine Frantz, Ed.D.

The University of Nebraska Teachers College, 1959

Adviser: Dr. J. Galen Saylor

The purpose of the study is to examine, describe, and analyze the various kinds of professional laboratory experiences which are now being provided prior to student teaching for students in teacher education at the secondary level.

The chief source of data was a questionnaire sent to the colleges and universities holding membership in the American Association of Colleges for Teacher Education. The seventeen-page questionnaire was designed to obtain a description of the program of professional laboratory experiences, those involving both school and non-school groups, offered at each institution. Usable replies were received from 71.5 per cent of those asked to take part in the study. A secondary source of data was the visitation to the campuses of six institutions selected for study. Persons contacted included the head of the department of

education, the coordinator of student teaching, the administrator of the campus laboratory school and college instructors.

The findings show that professional laboratory experiences are widely accepted as a part of the training received by prospective secondary teachers. Some such experiences are offered by 87.7 per cent of the institutions prior to student teaching. The percentage of institutions that offer each of the professional laboratory experiences is impressive:

	Per cent
1. Experiences involving school groups	
a. observes classes	83.0
b. makes case study	55.7
c. assists classroom teacher	41.9
d. assists school officials	22.1
e. works with extra-curricular activities	31.6
f. engages in "September experience"	28.9
2. Experiences involving non-school groups	
a. observes groups	35.2
b. makes case study	30.4
c. visits appropriate agencies or places in the community	33.6
d. works with community agencies	27.7
e. works with business or industry	10.3

The study shows that those experiences involving school groups are considerably more frequent than those involving non-school groups. There is a general tendency to concentrate both of these types of experiences in the junior and senior years. The freshman year is almost entirely neglected as a time for professional laboratory experiences as are the summer between the college years.

A higher per cent of colleges and universities offering professional laboratory experiences require them rather than permit them to be elective. The per cent is not as large in those experiences involving non-school as in school groups. Professional laboratory experiences are usually a part of regular course work rather than a separate experience for which no credit is given. There is a general lack of laboratory experiences provided through academic courses; in most schools they are confined to courses in professional education.

Professional laboratory experiences involving school groups take place most frequently in public, off-campus schools. Only rarely are these experiences limited to the campus laboratory school, although a sizeable number of institutions use both types of schools. Institutions not having a laboratory school of their own are not seriously handicapped in providing a full program of these experiences prior to student teaching.

Supervision and evaluation of professional laboratory experiences are done cooperatively by persons from the institution and the school or agency involved. Personnel of the department of education keep in close contact with the student during the time he is participating in these experiences.

The amount of time spent by the student in each of the separate kinds of professional laboratory experiences is quite limited. In institutions that require a wide range of experiences, however, the time spent by the student is sizeable when added together. The size of the institution has little or no influence on the number of experiences

offered or the time spent in them.

Microfilm \$3.15; Xerox \$10.80. 241 pages.

**TEACHING AND NON-TEACHING GRADUATES OF
HOME ECONOMICS EDUCATION CURRICULA:
A COMPARISON OF THEIR VALUES AND
OTHER CHARACTERISTICS**

(L. C. Card No. Mic 59-2022)

Anna Marguriette Gorman, Ed.D.
University of Illinois, 1959

Women throughout the centuries of recorded history have taken many roles. In the twentieth century, women are contributing to two major roles: the role of being a wife and mother, and the role of being a worker outside the home.

Teaching is a profession which to a large extent is staffed by women--over 75 per cent of all teachers.¹ In home economics, 99 per cent of the teachers are women.² The problem of educating sufficient numbers of women teachers is acute. Furthermore, there is little assurance that an increase in the number of potential teachers will increase the number who teach. Marriage and teaching are considered mutually exclusive choices to some potential teachers.

This study was designed to explore the personal characteristics which tend to distinguish a married graduate in home economics education who will likely teach from the married graduate who will not teach. An attempt was made to assess a significance value to the variables which tend to distinguish the teacher from the non-teacher.

Subjects

The subjects were 256 recent (1953 through June, 1956) married graduates in home economics education. Fourteen state colleges and universities in nine states of the North-Central Region in Home Economics were used in the study. One hundred and forty of the subjects were teaching; 116 of the subjects were not teaching.

Procedure

The heads of the home economics education departments of the state colleges and universities were requested to submit names of the recent married graduates of that curricula. The first 400 names submitted were used as the sample.

Four tests were sent to the subjects: Allport, Vernon, and Lindzey's "Scale of Values," Kuder's, "Personal Preference Form" and "Vocational Preference Form," and the author's "Personal Data Inventory."

For the three standardized tests, the statistic *t* was used for deciding whether to accept or reject the null hypothesis of mean differences, and the *F* test for deciding whether to accept or reject the null hypothesis that the population variances were equal. The chi-square statistic was used to test the null hypothesis that the personal characteristics, considered separately, were independent of the factor of teaching--non-teaching.

Results

One of the twenty variables in the three standardized tests was significant at the .01 level--the social service

scale of the Kuder "Vocational Preference Form." The non-teachers mean was significantly larger than the mean for the teacher group.

The author's "Personal Data Inventory" had nine items which were significant at the .01 level. These items were: plans for graduate work, reasons for teaching after marriage, benefits received from teaching, number of children in the family, present financial status, professional reading, husband's belief concerning wife's home responsibilities, husband's participation in school events, and husband's assistance at home while wife is working.

Conclusions

The results of this exploratory study found that significant differences tend to exist between those graduates who teach and those who do not teach. Further research is needed to verify the findings. The findings of the study could give direction for educational changes in the undergraduate program in home economics education. The significant item of social service points out the great need for emphasizing the social service role home economics teachers are playing in today's society. The significant items from the "Personal Data Inventory" should encourage curriculum planners to provide experiences which would educate the undergraduate student: to more fully understand the graduate school program, to arrive at reasons for teaching, to be able to express beliefs of benefits received from teaching, to prepare for the reality of financial reimbursements in teaching, and to read and use the materials from professional periodicals.

Microfilm \$2.00; Xerox \$6.00. 125 pages.

1. U. S. Department of Labor, Women's Bureau, 1956 Handbook on Women Workers (Washington, D. C.: U. S. Government Printing Office, Bulletin No. 261, 1956), p. 9.

2. National Educational Association, "The Status of American Public School Teacher," National Education Association Research Bulletin (Vol. XXXV, No. 1, February, 1957), p. 28.

**AN INVESTIGATION OF THE EFFECT AN
OUTDOOR EDUCATION EXPERIENCE HAS UPON
ELEMENTARY EDUCATION STUDENTS'
UNDERSTANDING OF HOW LEARNING IS FACILITATED**

(L. C. Card No. Mic 59-1906)

William Morris Hammerman, Ed.D.
University of Maryland, 1958

Supervisor: Professor Walter B. Waetjen

Purpose:

This study was undertaken with two purposes in mind: first, to determine whether or not an outdoor education experience makes a significant contribution to pre-service teachers' understanding of the learning process; and second, to investigate the general problem of measuring an individual's understanding of how learning is facilitated.

Procedure:

A basic before-and-after type design was established in order to determine the amount of change in the students' understanding of the facilitation of learning due to the

outdoor education experience. Measurements before and after the semester were also made so that the outdoor program could be seen in broader perspective to the total educational program.

The subjects used in this study were selected from the elementary education majors who were enrolled in the sophomore, junior, or senior seminar blocks at Northern Illinois State College. The basic instrument utilized in determining the students' understanding of the facilitation of learning was a fifty item Q-Sort on Learning. In addition, the subjects were tested by the Bill's Index of Adjustment and Values and the A. C. E. Psychological Examination for College Freshmen.

Each student's set of four Q-sort distributions were correlated with a criterion group composed of the seminar block and outdoor education professors. Q-correlation coefficients were computed for each subject and then grouped according to academic year, personality type, mental ability, student teaching, and non-student teaching. The mean Q-correlations of these groups represented the degree of closeness in over-all agreement with the criterion group. An increase in the magnitude of the mean Q-correlation coefficient meant a positive change in the students' understanding of the facilitation of learning.

Findings:

It is shown through this investigation and the way in which it was conducted that this outdoor education experience did not cause elementary education students of any particular academic level, personality type, or mental ability, to increase, significantly, their understanding of the facilitation of learning. Likewise, their seminar block programs for the semester did not cause a significantly positive change to take place in their understanding of the facilitation of learning. It was found that elementary education students have a statistically high correlation of agreement with the criterion group before the beginning of the semester's program and outdoor education experience.

In addition, it is established in this study that certain aspects of understanding the learning process can be investigated and measured in a valid and reliable manner.

Microfilm \$2.10; Xerox \$7.40. 157 pages.

THE DEVELOPMENT AND USE OF A PRE-STUDENT-TEACHING EVALUATION PROCEDURE IN INDUSTRIAL ARTS TEACHER EDUCATION

(L. C. Card No. Mic 59-1909)

Paul T. Hiser, Ed.D.
University of Maryland, 1958

Supervisor: Dr. R. Lee Hornbake

The Problem:

This study presents the development and application of a pre-student teaching evaluation procedure in the industrial arts division of the State University Teachers College at Oswego, New York, 1950-1956.

The investigation was based upon the premises that evaluation of teacher candidates should be broadly conceived and continual following admission; that such a procedure can contribute to student advisement, self-appraisal, and more discriminating selection of prospective teachers.

The Procedure:

The study involves:

- (1) A review of literature regarding factors related to teacher success and the measures of selection and retention employed at the pre-service and in-service levels.
- (2) The concurrence of the college faculty concerning selected traits and qualities which appear to be related to teaching success.
- (3) The development, use, and statistical analysis of a rating instrument, the Student Professional Inventory (SPI), involving ten personal and professional traits and qualities.
- (4) The development and use of a cumulative record appropriate for summarizing ratings and other personal data useful to faculty and students.
- (5) The development of administrative procedures related to the evaluation project.

Using the SPI, sixty-one faculty judges rated 327 industrial arts majors as they progressed from the freshman year to the student teaching experience providing 1886 ratings. These ratings, along with scholastic indices for the first three years, were correlated with the criterion of their student teaching success as rated by two or more cooperating teachers serving in student teaching centers.

Findings:

- (1) The estimate of reliability for the composite SPI, derived from repeated ratings, was $r_{11} = .658$, significant at the .001 level.
- (2) The estimate of reliability for each of the ten items of the SPI was calculated by intraclass correlation using a random sample of 65 students rated by 50 judges. Reliability coefficients for nine items ranged from .327 to .628, significant at either the 5 or 1 per cent levels. The "ability to achieve cooperation" produced a positive but low $r_k = .192$ indicating it was less amenable to evaluation in the shop or classroom than the other items.
- (3) The validity coefficient between the mean score of each item of the SPI and the criterion for 327 cases ranged from .314 to .472, all significant at the .001 level.
- (4) The F Test, when applied to each critical regression, proved linearity.
- (5) The Pearson r between the variable of composite SPI ratings and the criterion was .498; between the variable of three-year scholastic indices and the criterion was .451, each significant at the .001 level.
- (6) A multiple correlation using the two independent variables, SPI composite ratings and three-year scholastic indices, produced an r of .524 with the criterion, significant at the .001 level.
- (7) From the b-coefficient ratio, the SPI ratings proved to be two and one-third times more valuable in estimating a student's expected performance in student teaching than scholarship.

Conclusions:

- (1) The SPI instrument proved to have satisfactory reliability required for a rating device of this nature. It was both useful and practical and adaptable to as many faculty raters as was deemed necessary and desirable.
- (2) As single predictors, both SPI ratings and scholastic indices had substantial value to selected and evaluation procedures.
- (3) The combined value of SPI ratings and scholarship was a stronger predictor for student teaching success than either one alone.
- (4) The use of the cumulative record, developed in this

study, was essential to this teacher education program for referral and advisement purposes and furnished data for other research studies.

(5) Participation of students in initiating and maintaining their own records proved to be desirable and feasible, and demonstrated an educational practice considered pertinent to the preparation of teacher candidates for their future work with children and youth.

(6) Studies leading to the discovery of other factors of prediction, in addition to scholarship and personal and professional traits and qualities, should be encouraged for possible use in the evaluation program at Oswego.

Microfilm \$5.80; Xerox \$20.20. 454 pages.

AN EXPLORATORY STUDY OF INTERPERSONAL PERCEPTIONS OF STUDENTS AND TEACHERS IN SELECTED NINTH GRADE CLASSES

(L. C. Card No. Mic 59-1031)

Ardelle A. Llewellyn, Ed.D.
New York University, 1958

Chairman: Professor Walter A. Anderson

Problem

The problem of this study was focused on two main concerns: (1) to explore, with certain students in ninth grade classes and their teachers, their perceptions of interpersonal behavior revealed in the classroom, and (2) to examine selected aspects of the classroom situation in which the perceptions were found to be operating. This was an exploratory study carried on for the purpose of identifying the interaction between interpersonal relations in the classroom and the quality of learning.

Procedure

The study was conducted in a four-year academic high school in New York City. The population consisted of eighty-one students in three core classes and the three core teachers of these classes. A sub-group of the population, consisting of a selected group of four students from each of the three core classes, was studied more intensively. These twelve students were interviewed to extend and clarify the responses received from the eighty-one students who completed the questionnaire.

Evidences relative to interpersonal perceptions of students and teachers were derived from these sources: (1) oral and written statements of students and teachers, and (2) notations on classroom observations made by the investigator.

The instruments used for securing these data were: (1) an open-ended questionnaire which asked teachers to indicate what students do that they like and dislike and asked student to indicate what teachers and other students do that they like and dislike. This questionnaire was an adaptation of the "basic question" approach developed by Jenkins and Lippitt. (2) a Self-Analysis Rating Scale for analyzing the extent to which group processes were used in the classroom, (3) the Ohio Social Acceptance Scale which measures the individual's acceptance by the group, (4) a rating scale for measuring the effectiveness of group membership roles by assigning a numerical value to the

three types of group roles: task, maintenance, and individual, and (5) an interview schedule used with the sub-group of twelve students.

Findings

1. The students' questionnaire responses strongly emphasized the importance of emotions in interpersonal relations in the classroom.

2. The students' questionnaire responses placed a high value on the qualities of friendliness, helpfulness, and consideration of their classmates. Students reported a dislike for clowning, scapegoating, showing-off, and rowdiness.

3. In describing the teachers, the students' questionnaire responses indicated as liked behavior: showing consideration, showing helpfulness, and giving interesting work. Students reported a dislike for teachers' nagging, yelling, humiliating, being strict, and giving too much homework.

4. The questionnaire data from teachers indicated a strong liking for students who show respect, assume responsibilities, and do satisfactory work. Teachers reported a dislike for students who show disinterest in school work and who are aggressive.

5. The measurements of each individual's effectiveness as a group member showed an overall tendency toward positive group functioning.

6. A significant correlation was found between the social acceptance ratings of this individual by the group and his group effectiveness. It was inferred that students tended to use the same criteria for judging an individual's social acceptance as for judging an individual's effectiveness in group functioning.

7. Teachers' judgments of the functioning of group processes in their classrooms tended to be in the ranges on the Self-Rating Scale that indicated, "Almost always," or "More often than not." They rated their own classrooms more favorably than did the investigator or than the questionnaire responses from the students would seem to warrant.

8. Teachers endeavored to consider students' purposes but the investigator's observations in the classroom indicated instances when student and teacher purposes were in conflict or when student purposes were not intrinsically related to learning outcomes. At such times student participation and student interest tended to decrease; group productivity lessened.

Microfilm \$2.60; Xerox \$9.00. 199 pages.

CRITERIA FOR THE EVALUATION OF PROGRAMS OF STUDY LEADING TO THE MASTER'S DEGREE THAT PREPARE TEACHERS OF BUSINESS SUBJECTS FOR THE SECONDARY SCHOOLS

(L. C. Card No. Mic 59-2295)

Keith Edward Lucas, Ph.D.
The Ohio State University, 1953

The purpose of the study was to develop criteria that could be used to evaluate programs of study leading to the Master's degree that prepare teachers of business subjects for the secondary schools. Many statements have appeared in the literature of business education emphasizing the

need for graduate study programs. The nature of the graduate program has also been frequently discussed. Two points appear to stand out from the writings.

1. Teachers are seeking additional graduate work.
2. There is some question as to whether present graduate programs are providing the type of training that can be applied directly to the teaching of business subjects in the secondary schools.

These points show the need for the development of evaluating criteria for the Master's degree in business education.

The study was conducted in a series of separate steps pointing toward the establishment of evaluative criteria for the Master's degree in business education. Research conducted for each step was dependent, in large measure, upon the findings of the preceding step.

A survey of the literature in the field was made to determine the nature of the writings and research in the subject area and the pattern of business education at the graduate level recommended by previous research studies. Twelve studies were reviewed. Ten studies were concerned with recommended graduate business education programs for specific situations or factors to be included in a graduate program. Two studies were concerned with general requirements for the Master's degree. All studies reviewed were quite recent, covering a 20-year period from 1932 to 1951.

The 12 studies reported were summarized in the form of a composite program. In the construction of this program, recommendations took precedence over current status. The composite program was divided into three parts: (1) general requirements and conditions for graduate study that seem to be rather generally operative, (2) requirements that the graduate business education student will probably have to meet at a particular institution, and (3) curricula for the Master's degree in business education.

Analysis of the composite programs revealed several inconsistencies. Data were too incomplete to serve as the basis for the formulation of evaluating criteria. Additional data were needed.

It was decided to collect additional data concerning graduate programs in business education by making an analysis of existing programs in this area. A list of 156 institutions was compiled for analysis. Initial screening revealed 77 institutions from this list which could be classified as institutions offering a graduate program leading to the Master's degree in business education. Correspondence with the persons in charge of these programs brought letters from 6 stating that they did not consider that their institution offered such a program. These 6 were deleted from the list, leaving 71 institutions offering a Master's degree in business education.

Analysis of the graduate programs in business education of the 71 institutions was made from the letters, catalogues, and circulars received. A composite of the Master's degree program in business education was constructed. In actual practice no one program followed this pattern completely. The composite program of actual practice was compared with the composite program recommended by research. Areas of other than complete agreement were investigated in further research.

A comparison of recommendations resulting from research and current practices pointed up seven major areas

of disagreement. It was decided that the one group of people most likely to have given consideration to these problems would be those persons in charge of the existing graduate programs in business education. A questionnaire was developed to obtain the desired information. The questionnaire method was chosen because of the number and distribution of the institutions to be investigated.

At various times during the period of construction, the questionnaire was presented to five doctoral students in business education at The Ohio State University for their comments concerning the understandability and appropriateness of the questions. The questionnaire was further examined by ten respondents for brevity and appropriateness before being submitted to all respondents.

Completed questionnaires were received from 58 persons in charge of graduate business education, 5 persons in charge of graduate business administration, and 16 persons in charge of graduate teacher education. Returns were considered to be adequate for the purpose of the study. The teacher education and business administration groups were included to make it possible to compare points of view and to determine if the thinking of business educators conforms to that of educators in other areas in which business education students would be expected to take courses. It was realized that some of the questions dealing with courses to be required would prove unanswerable to other than the business education group.

The opinions of the respondents to the questionnaire were tabulated and analyzed. The analysis of the responses developed areas for further research. Some were new; some were problems that the investigation had not solved.

As a result of all previous investigations, six problems were in need for further study. Solutions were sought in the following research: 1. analysis of 32 recent Master's degree programs in business education granted by 3 institutions—the institutions were selected because of their philosophy, size, breadth of offerings, and location; and 2. nine interviews—six of the interviews were with directors of graduate business education programs who were selected for interview on the basis of their responses to the questionnaire; three interviews were obtained with persons outside the field of business education who were selected because of their experience with certain aspects of the topic under investigation.

The findings from all sources were analyzed, the results of the research were added to the findings of previous research done for this study, and evaluative criteria were prepared.

Criteria useful in the evaluation of graduate programs in business education were constructed from the data obtained from all sources. Those criteria follow.

1. The use of a special designating title for the Master's degree in business education should not be considered of importance. Its use is optional.
2. The purpose of graduate study in business education should be the improvement of the ability to teach.
3. Only those students who have obtained a Bachelor's degree from an institution deemed to be in good standing with an accrediting agency recognized by the graduate school, or who possess equivalent preparation, should be admitted as graduate students in business education.
4. Only those students who have furnished evidence of an adequate undergraduate background to permit them to

conduct advanced work in the business education field should be admitted to the graduate program in business education.

5. No specific undergraduate scholastic average beyond that needed to obtain the Bachelor's degree should be required for admission into graduate study.

6. Demonstration of the ability to teach could be a prerequisite for the granting of the Master's degree in business education.

7. Each graduate program should be tailor-made for the individual student.

8. Permission to enroll in any class for graduate credit should be granted the graduate student on the fulfilling of the following prerequisites-

- a) The course will improve the student's ability to teach.
- b) To enroll in courses in business education and general professional education, the student should have teaching experience.
- c) To enroll in courses in the subject matter teaching fields, the student should have the course prerequisites.

9. An average grade of B in all graduate work should be required for graduation. Graduate credit should not be granted for grades below C

10. The graduate student should remain in residence at the institution granting the degree for a period of at least one academic year or the equivalent.

11. The number of semester hours of credit required for the Master's degree in business education should not exceed twice the maximum number of semester hours the student is permitted to carry each semester of full-time enrollment.

12. The final examination should be tailor-made for the individual student.

13. Competency in the use of research techniques should be required of all graduate students in business education.

14. A reading knowledge of a foreign language should not be required for the Master's degree in business education.

15. Graduate business education courses should be offered in the following areas: principles and problems of business education; improvement of instruction in office practice, stenographic courses, bookkeeping, general business, and retail selling; curriculum construction in business education; administration, organization, and supervision of business education; special problems; and seminars in current problems, literature, and research.

16. Extensive course offerings should be available in the following areas: secondary education, psychology, philosophy of education, vocational education, guidance, marketing, management, and economics.

17. Instructors of graduate courses have the responsibility for improving the student's ability in written expression.

18. Provision for independent study of special problems should be included in the various classes in the graduate program to the extent feasible and consistent with the desired program outcomes.

19. The seminar method of curricular organization should be used when the desired course outcome is principally the development of principles or problems.

20. Extra work assigned graduate students enrolled in classes designed primarily for undergraduates should improve the ability to teach.

21. Integration of graduate instruction with full-time teaching should be facilitated.

Other research problems are suggested as a result of the findings and the procedures used in this study.

1. The conclusions and criteria developed in this study were an outgrowth of the viewpoints expressed by the majority of the directors of business education graduate programs. A small minority disagreed with certain basic viewpoints. It would be profitable to business education for a study to be made of this minority view. Such a study would permit a more careful evaluation of the position of both the majority and the minority.

2. Research studies of graduate business education have listed courses of instruction that should be provided in a graduate business education program. These are inadequate objective data in these studies as to why certain courses are selected by students. A more comprehensive study is needed to determine the reason why certain courses are deemed valuable by directors and students.

3. It has been noted in this study that there is a uniformity of courses selected by graduate students in any given institution. The reasons for this uniformity are unknown. A study of why students wish to attend graduate school, what they expect, and why they choose the institutions they do would do much to confirm or reject many of the criteria concerning the nature of graduate study and the planning of the programs for the individual student.

4. In the study, course titles have been used as the method of description of content. It has been found that there are considerable differences among institutions as to courses selected by graduate students with similar backgrounds, and, as far as could be determined, similar ambitions. These differences have been explained in the study as being caused by the relative strength of various departments in the different institutions. These differences may not be caused by departmental strengths but by a different means of organization with the same content present under different titles. A study to determine the topics discussed rather than the courses studied would be of great value to graduate business education.

Microfilm \$4.85; Xerox \$16.20. 380 pages.

Abstract published by special arrangement with The Ohio State University.

AN EVALUATION OF THE OHIO TEACHER EDUCATION PROGRAM FOR TRADE AND INDUSTRIAL EDUCATION TEACHERS

(L. C. Card No. Mic 59-2313)

Robert Max Reese, Ph.D.
The Ohio State University, 1954

The Problem

The study was made for the purpose of determining (1) what the major problems of beginning trade and industrial teachers are; and (2) how effective Ohio's program of teacher training has been in helping teachers with the solution to these problems.

Procedures Utilized

The study consisted of the following sequence of steps:

1. A check list of a series of factors which imply potential problems for beginning teachers was developed.
2. The check list was validated by submitting it to a jury of specialists.
3. The check list of 95 factors was then submitted to a study group of 275 Ohio trade and industrial teachers. These teachers were asked to check those factors which represented problems to them as beginning teachers and also to indicate whether or not they received instruction from their teacher training that helped them with the problems. A total of 240 teachers responded to the check list. This response represented 87.27 per cent of the teachers to whom the check list was submitted.
4. The responses of the study group were tabulated and organized for use in the study.

Pertinent Findings

Facts Concerning Problems of Beginning Teachers.-

Each of the 95 check list factors was verified by the study group as a potential problem for a beginning trade and industrial teacher.

The following eighteen factors represented problems during the first four years of teaching for more than 60 per cent of the teachers responding:

1. How to select and organize instructional materials
2. Understanding the federal, state, and local relationship in vocational education
3. The importance of trade analysis as a foundation to trade teaching
4. The objectives and purposes of vocational trade and industrial education
5. The history of vocational education
6. How to develop a course of study
7. Methods of measuring student progress
8. Procedures for correlating shop and related technical instruction
9. How a vocational trade and industrial education program fits into a community education program
10. A knowledge of the proper methods for planning a lesson
11. The philosophy underlying all vocational education
12. Adequate methods of recording student progress
13. How to use a trade analysis for determining teaching content

14. How to use written instruction sheets
15. How to use the "Allen" four-step method of organizing and presenting a lesson
16. Various types of tests and how to develop tests for classroom use
17. The relationship of trade and industrial education to industrial arts
18. Criteria for student selection

The following factors were found to represent problems for more than 40 per cent but less than 60 per cent of beginning teachers submitting the check list:

1. Methods of motivating student interest
2. The relationship of vocational trade and industrial education program to the total school
3. Developing an effective system of records and reports for the classroom
4. Different teaching methods and how to vary their use
5. Standards of workmanship to be expected of students
6. Sources of instructional aids and materials
7. The relationship of the trade and industrial program to local industries
8. Using conference questioning techniques for teaching
9. How to give an effective demonstration
10. Types of visual aids and how to use them
11. Individual differences of students and how to provide for them
12. How to provide individual instruction in a class
13. Understanding and use of intelligence and aptitude tests
14. Methods of assisting students in developing good work habits, social attitudes, and leadership qualities
15. Effective use of visual aids
16. The relationship of trade and industrial teachers to other teachers in the school
17. Preparing and selecting practical visual aids
18. How public education operates
19. How to teach to the learning level of the class
20. How to organize an orderly, efficient system of handling tools and supplies
21. When and how to provide group instruction
22. How to use questions effectively
23. Selecting proper jobs on which to develop skills in shop
24. Relationship between teacher and pupil
25. Understanding adolescent psychology
26. The principles of learning and how to use them in teaching
27. How to provide for safety in the shop or laboratory
28. Standards for developing written teaching aids
29. Understanding labor-management relationships
30. How students learn
31. How to organize for orderly entrance and exit from classroom
32. How to be resourceful in teaching
33. Methods of beginning instruction promptly in each class
34. Techniques for developing in students respect for tools, materials, and equipment
35. Selecting proper instructional materials to match level of student
36. Understanding the proper channels and lines of authority within the school system
37. Methods of promoting group participation and cooperation in the classroom

38. How to organize and use a student shop personnel system
39. Effective use of displays, bulletin boards, and posters in the classroom
40. Instructor's responsibility for coordination
41. Providing leadership experiences for students in class
42. Utilizing student-teacher planning in the shop or laboratory
43. Establishing adequate records for materials and supplies
44. Planning for an effective and convenient shop or laboratory layout
45. The principles and practices of proper student job placement
46. Obtaining student participation in making visual aids and other instructional materials
47. Providing for first aid, safety, and fire protection in the shop or laboratory
48. How to extend his knowledge of his trade
49. How to plan and conduct industrial visits

The following factors represented problems for less than 40 per cent of the respondents:

1. The instructor's responsibility for housekeeping in the shop or laboratory
2. How to maintain effective contacts with trade and keep up to date with trade practices
3. How to organize class for the maintenance of proper order
4. Planning for effective organization and management of tool cribs
5. Responsibility for vocational staff participating in school staff activities
6. Planning a well-selected and accessible reference library for shop and related laboratory
7. A teacher's responsibility to professional organizations
8. How to provide for adequate and effective supervision over the class
9. Techniques for keeping reference materials up to date
10. Proper methods of storing instructional supplies
11. How to develop a professional attitude toward teaching
12. Proper location, maintenance, and care of materials and supplies
13. How to organize and maintain orderly storage and supply rooms
14. How to express enthusiasm in teaching
15. Maintaining a thorough knowledge of the industrial standards and practices of the trade
16. Teacher's responsibility for proper heat, light, and ventilation in the classroom
17. Understanding that teaching is not an 8 a.m. - 4 p.m. job
18. How to correct harmful personal habits or mannerisms
19. Techniques of oral expression
20. How to make maximum and effective use of available equipment
21. How to remain emotionally stable in the classroom
22. Effective use of the voice
23. Developing an interest in, and participating in, school and community affairs
24. Proper selection of shop or laboratory equipment
25. Developing a cheerful attitude in the classroom
26. Techniques of getting along with others

27. Proper dress and personal appearance for trade and industrial teaching
28. Keeping physically fit for teaching

Facts Concerning the Effectiveness of Trade and Industrial Teacher Training.—On 74 of the 95 factors 80 per cent or more of the teachers responding reported that their teacher training program had provided instruction which helped with their problems as beginning teachers.

On 21 check list factors 20 per cent or more of the teachers responded that help had not been received. These 21 listed under the check list headings were:

Personal Qualities

1. How to correct harmful personal habits or mannerisms
2. Techniques of oral expression
3. How to remain emotionally stable
4. Developing a spirit of interest and participation in school and community affairs
5. Developing a cheerful attitude in the classroom
6. Techniques of getting along with others
7. Keeping physically fit for teaching

Teaching Techniques

1. The principles and practices of student job placement
2. How to plan for and conduct industrial visits

Class Organization and Management

1. Techniques of obtaining orderly entrance and departure of students from classroom
2. How to organize the class to start instruction promptly
3. How to provide for the development of leadership qualities in students
4. How to organize a well-selected and accessible reference library

Instructional Materials, Exhibits, and Visual Aids

1. How to develop respect for, and care of, tools and materials used by students
2. How to keep references up to date
3. Proper storage of instructional supplies

Instructor Knowledge and Activities

1. Maintaining a thorough knowledge of the industrial standards and practices of the trade

Physical Conditions of Shop or Related Laboratory

1. Proper location, maintenance, and care of materials and supplies
2. How to organize and maintain orderly storage and supply rooms
3. Instructor's responsibility for proper heat, light, and ventilation in the classroom
4. Proper selection of shop or laboratory equipment

On only five factors did more than 30 per cent of the teachers respond that help had not been received from their trade and industrial teacher training program. These five factors were:

1. Keeping physically fit for teaching
2. How to remain emotionally stable
3. Techniques for obtaining orderly entrance and departure of students from classroom
4. Proper storage of instructional supplies
5. Proper selection of shop or laboratory equipment

Conclusions

The conclusions of the study are as follows:

1. Beginning trade and industrial teachers have a wide range of problems.

The data show that the fewest number of respondents who checked any one factor of the 95 as a problem was 45 and that the greatest number of respondents indicating any one factor represented a problem to them as a beginning teacher was 191. The fact that the mean (114) and median (109) number of responses only varied by five teachers tends to show that the distribution of responses over the entire 95 factors were in regular progression from the lowest response to the highest response that a factor represented a beginning teacher problem. Each of the 95 check list factors represented a potential problem to beginning trade and industrial teachers.

2. A fairly reliable list of problems of beginning trade and industrial teachers can be developed as a basis for a teacher training program. The list developed in this study appears to be fairly inclusive and valid.

The basis of this conclusion is that, first, a jury of nationally recognized specialists validated the list of factors and, second, that collectively the study group of 240 teachers responded that every factor in the check list represented a potential problem to a beginning trade and industrial teacher.

3. Trade and industrial teachers tend to agree on their identification of the major problems of beginning teachers.

The evidence presented shows that the range of responses that a factor represented a problem was fairly narrow for those factors placing in the first quartile in the total list of 95 factors. This range extended only from 57.2 per cent to 79.6 per cent of the respondents. The range of responses for those factors falling into the second quartile was 45.4 per cent to 56.6 per cent inclusive; for the third quartile 38.8 per cent to 44.2 per cent; and for those factors placing in the fourth quartile the range of responses was from 18.7 per cent to 38.3 per cent of the respondents.

4. Teachers do not recognize as potential problems their own personal characteristics or qualities.

The data show that the median per cent of response to all factors within this area of the check list was only 31.2 per cent, whereas for all other sections the median responses ranged from 36.9 per cent to 67 per cent. The area of "Personal Qualities" ranked last within the eight sections in terms of the reaction of the study group.

5. One of the major area of needs of beginning trade and industrial teachers involves problems concerned with techniques, practices, and resources to be used in providing instruction to the students.

The data show that of the 26 factors contained in this section of the check list eleven fall in the first quartile in terms of the response that the factor represented a problem to a beginning teacher; eleven fall in the second quartile; only four fall as low as the third quartile. This evidence shows that 21 of the 26 factors placed in the top 50 per cent of those factors which represented problems to the study group.

6. The most important factors in a teacher training program when viewed in terms of the expressed needs of beginning trade and industrial teachers were the following:

1. The federal, state, and local relationship in vocational education
2. The importance of trade analysis as the foundation of trade teaching

3. The objectives and purposes of vocational trade and industrial education
4. The history of vocational education
5. The place of vocational trade and industrial education in the local community
6. The philosophy underlying vocational education
7. The relationship of trade and industrial education to industrial arts
8. The criteria for student selection
9. The selection and organization of instructional materials
10. The assignment of grades for vocational student work
11. Correlating instruction between shop and related technical instruction
12. Methods of planning lessons
13. Recording student progress
14. Using trade analysis in planning course content
15. Using the four-step method of teaching — preparation, presentation, application, and test
16. Motivating students
17. Planning for adequate records and reports
18. The various teaching methods
19. Standards of workmanship for vocational students
20. Procedures for developing a course of study
21. The use of written instruction sheets
22. Different types of tests and their use
23. Sources of instruction aids and materials
24. The relationship of trade and industrial education to the total school

The data show that these 24 factors received sufficient responses from the study group, that each represented a problem to a beginning trade and industrial teacher, that they composed the top 25 per cent of the entire list of 95 factors. More teachers reported these factors as representative of problems to beginning teachers than the others contained in the check list.

7. The trade and industrial teacher training program provides help to most beginning teachers on their teaching problems.

This is evidenced by the fact that from 64.5 per cent to 100 per cent of the teachers responding on each factor reported that they received help.

8. Because of the wide diversity of problems encountered by most beginning trade and industrial teachers, an in-service teacher training program composed of short units appears to be more feasible and practical than a program of organized courses which operate for a full school period.

It is questionable whether a regular college teacher-training course could possibly be broad enough to encompass instruction that would help with these many different problems.

9. The trade and industrial teacher-training program has failed to devote sufficient attention to those problems of beginning teachers which may result from personal characteristics. This is evidenced by the fact that the percentage of teachers indicating that help was received was lowest in the area of "Personal Qualities."

Recommendations

1. Ohio's trade and industrial teacher-training program should attempt to strengthen its services in the areas of the teacher's personal qualities, and in the teacher's

responsibility for control of physical conditions in his shop or related laboratory.

2. The trade and industrial teacher training program should continue to be based upon the individual problems of the beginning teacher.

3. The trade and industrial teacher-training personnel implementing Ohio's trade and industrial teacher-education program should make a greater effort to relate the teacher-training instruction for related technical teachers and teachers of women's trades more closely to their trade field.

4. The present plan for training beginning trade and industrial teachers should be continued essentially as it is now operating.

5. A continuous program of evaluation should be utilized to keep the trade and industrial teacher-education program coordinated to changing needs and conditions affecting trade and industrial teachers.

6. Efforts should be made in the future to give experienced trade and industrial teachers a greater part in planning the teacher training program that is to serve their needs.

Microfilm \$2.10; Xerox \$7.40. 160 pages.

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THE RELATIONSHIP BETWEEN SELECTED FACTORS AND CERTAIN DIMENSIONS OF CLASSROOM LEARNING SITUATIONS

(L. C. Card No. Mic 59-2408)

Tongsoo Song, Ph.D.

University of Pittsburgh, 1959

This study is an investigation of factors related to differences in classroom learning situations, using a rather broad and objective measure of classroom practices as they actually take place in the classroom.

The specific problem of this investigation was to determine the relationships between selected factors and certain dimensions of classroom learning situations in public high schools. The selected factors and their component types are as follows:

1. Type of institution in which teachers received undergraduate education: teachers college, liberal arts college, and university.
2. Length of teaching experience: teachers with less than five years of experience and those with more than five years of experience.
3. Subject matter area: English, social studies, science, and mathematics.
4. School system: the Residential Community, the Community with Small Industry, and the Community with Large Industry.

The dimensions used were those included in the instrument used in this study, the Classroom Observation Schedule, namely: (A) Differentiation, (B) Social Organization, (C) Pupil Initiative, (D) Content, (E) Variety, (F) Competency, (G) Climate-Teacher, and (H) Climate-Pupil.

For purpose of investigation, a sample of 66 classrooms and teachers were selected from certain public high schools of Allegheny and Westmoreland Counties of Pennsylvania. Results were obtained by the writer from classroom observations, and were investigated by the analysis of variance to find differences existing in classroom practices among the selected types of each factor.

Significant differences existing in certain dimensions of the classroom situations observed among the component types of the selected factors were found as follows:

1. Significant mean differences on (F) Teacher Competency were found among teachers with teachers college, liberal arts college, and university background in favor of the order given.
2. The mean score on (H) Climate-Pupil for classes taught by more experienced teachers was significantly higher than that of the classes taught by less experienced teachers.
3. The (D) Content dimension showed significantly higher mean score for English, social studies, science, and mathematics in the order given. This would indicate the relative amount of provision made for interest and meaningfulness of content material to students in a decreasing order.
4. With respect to school system, significant mean differences were found on two dimensions: (E) Diversity, and (H) Competency.

Although the above differences were found, most of the dimensions included did not show significant differences associated with the selected factors. It was therefore concluded that the factors studied in this investigation contribute little to differences in overall classroom learning situations. However, since classroom learning situations are extremely complex, the evidence resulting from a limited study, such as this, must be related to past studies and supplemented by future research, before any definite conclusion may be attempted concerning the status of such factors.

Numerous studies have been made in an effort to secure a valid measure of instructional effectiveness, but none of the existing measures seem to be satisfactory. The writer feels that the use of the selected dimensions provided comprehensive and useful criteria in evaluating classroom procedures and that the instrument used enabled a descriptive and relatively objective comparison of instructional practice as observed in the classroom.

Microfilm \$2.00; Xerox \$4.60. 88 pages.

EDUCATION, THEORY AND PRACTICE

THE EFFECT OF ABILITY GROUPING IN THE HIGH SCHOOL UPON ACHIEVEMENT IN COLLEGE

(L. C. Card No. Mic 59-2077)

David A. Abramson, Ph.D.
New York University, 1959

Chairman: Professor Louis E. Rath

The study was intended to investigate the achievement in college of high-ability graduates of New York City high schools which had used different methods of ability grouping. A selection was made of four schools which had adopted the following methods for grouping pupils of high intelligence and achievement:

1. A high school in which high-ability pupils were grouped heterogeneously with pupils of all levels of ability; this was the control school of the study.
2. A high school which placed high-ability pupils in honor classes for one or two major subjects.
3. A high school which selected high-ability pupils for membership in an "honor school," assigning them to honor classes for most of their major subjects.
4. A special high school which admitted only gifted pupils.

The problems chosen for investigation were concerned with comparisons of the achievement in college or graduates of the four schools by means of three criteria: (1) grade-point averages, (2) honors, and (3) grades in specific courses. From each school a sample was randomly drawn of forty-eight graduates who met the intelligence and achievement standards for admission to any of the special classes or schools, and who had completed the sophomore year in college. Each sample consisted of equal numbers from each sex, and from three levels of intelligence: 115-124, 125-134, and 135-160; one-half of each sub-group was made up of students attending the municipal colleges of New York City. The samples of graduates of the four high schools did not differ significantly in intelligence or chronological age, and there were no marked differences among the schools in curricula or methods of enrichment or teaching.

Comparisons of the grade-point averages and honors earned in college by the four groups of high school graduates were made separately for the freshman and the sophomore years, and for both combined. Achievement in specific subject areas was examined by grades earned in courses classified by judges as representing comparable content and level. All three of the criteria were applied to the total group of students, and separately to those attending the municipal colleges.

Statistical analysis of the data resulted in the following findings:

1. In no test were any significant differences observed in the college achievement of graduates who had experienced ability grouping in high school and those who had been grouped heterogeneously.
2. Grade-point averages significantly superior to those of boys were attained by the girls of the total group, but not by those of the municipal college group. No differences were observed between the sexes in regard to honors, or grades in specific courses.
3. Students from the three levels of intelligence differed significantly in grade-point averages earned, except

for the freshman year of the municipal group. Furthermore, intelligence level was the only variable producing significant differences for the criteria of honors and course grades.

4. Effects of the interaction of schools, sex, and intelligence levels were not significant.

Measured by the achievement in college of the high-ability students included in the investigation, no superiority of preparation can be claimed for either the special high school or the honor class program, as compared to heterogeneous grouping within the comprehensive high school. Achievement of students was associated with intelligence level rather than the particular high school attended. Since pupils in the current study had experienced a high school curriculum substantially equivalent to that recently proposed for the academically talented, it is recommended that future research be directed toward more marked changes in curricula and/or methods of teaching the high-ability student. Microfilm \$2.65; Xerox \$9.20. 204 pages.

THE ANALYSIS OF CLASSROOM DISCOURSE:
A METHOD AND ITS USES

(L. C. Card No. Mic 59-1998)

Mary Jane McCue Aschner, Ph.D.
University of Illinois, 1959

This study reports the development and initial testing of a set of descriptive criteria used in defining and identifying units of classroom discourse as these are found in the moment-to-moment record of verbal behavior observed in the classroom.

The problem dealt with arose in connection with a study of teaching practices in the high school classroom as they bear upon the thinking noted in the performances of high school students during periods of instruction, recitation, and discussion. In the fields of English, social studies, mathematics, and science, grades nine through twelve, the major portion of class time is spent in these primarily verbal activities. They proceed in and through a sustained and nearly continuous series of verbal actions and interactions among teacher and students. It is assumed that both the operations of teachers and the thinking performed by students under instruction are traceable in classroom verbal behavior, if and when such behavior is viewed in the immediate and living context of its performance.

Consequently, the analysis of teaching and thinking--as well as of other forms of teacher-student interaction--is effected in the analysis of classroom discourse, i.e., the series of verbal actions and responding actions carried on by teachers and students while the class is actively in session. It became necessary to break up the gross data of observation--say, the moment-to-moment record of a forty-five minute class session--into units. To be useful, such units must embrace unitary sequences of verbal behavior within a sustained series of verbal actions and interactions, distinguishing any one such unit of behavior from those adjacent to it. The unit must also be identifiable in the data by independent observers with a high degree of reliability. Finally, the unit must permit the analysis, classification, and comparison of instances of classroom discourse from class to class and across subject fields and grade levels.

The requisite unit was constructed from observation of classroom verbal behavior. Seventy-four class sessions from fifteen classes in five Illinois public high schools were tape-recorded. These recordings were transcribed verbatim. Detailed observer's notes supplying relevant contextual data supplemented tape recordings and transcripts. Extended survey and close analysis of both tapes and transcripts revealed a set of characteristic verbal behaviors found to be common to all class sessions studied. Furthermore, the sequential patterns into which these series of verbal actions and interactions fell could be traced so as to mark the ebb and flow, give and take so typical of group discussion. One such sequence could be marked off from another by noting significantly recurrent verbal cues and by noting concurrent shifts among speakers and in the movement of discussion from topic to topic, point to point. Two behavioral units seemed discernible in the flow of classroom discourse. One of these involved the verbal exchanges among two or more speakers; the other consisted in the sustained verbal action of one speaker, uttered without exchange of remarks with any other speaker. These two recurrent patterns of individual and group verbal behavior gave rise to the two forms of unit developed for the analysis of classroom discourse, the Episode and the Monologue.

An instrument was then developed which could serve in identifying the episodes and monologues occurring in a given class session. It consists in a set of descriptions serving as defining criteria for those common and recurrent features of classroom discourse by means of which the "breaking points" between adjacent sequences of verbal action and interaction may be marked. The instrument was then put to a series of preliminary tests of its reliability. Four analysts, none of whom had taken part in the development of the instrument, conducted the test by making independent analyses of each of ten tape transcripts. The instrument, as tested in provisional form, was found to achieve a range of reliability from .70 to .93 by the four analysts. Microfilm \$2.85; Xerox \$9.80. 219 pages.

A STUDY TO DETERMINE WHETHER MENTAL AGE SCORES ARE BEST DESCRIBED BY SINGLE-CYCLE, MULTI-CYCLE, OR STRAIGHT LINE GROWTH EQUATIONS

(L. C. Card No. Mic 58-5318)

Richard McCallum Clark, Ph.D.
Michigan State University, 1958

The purpose of this study was to find which of three methods of describing the mental growth scores collected longitudinally for one hundred individuals would most accurately describe the growth pattern formed by the actual test scores of these individuals. The three methods used described mental growth as: (1) a straight line; (2) a single-cycle negatively accelerated curve; and (3) a multi-cycle curve. It was assumed that a statistically significant difference in these three methods of describing the obtained mental age scores for an individual would indicate that the more accurate method represented a more nearly correct theoretical picture of the nature of the mental growth curve.

Cases were selected from the Dearborn data assembled by Doctor C. V. Millard from the Henry Ford School, Dearborn, Michigan, on the basis of a range of test scores obtained during the pre-adolescent period and on the basis of physical growth indications, extending into the adolescent period, and including a minimum of six mental age scores for the individual.

A straight line growth description was obtained by multiplying the mean I.Q. obtained by an individual by the chronological age at the time of each test administration. Single cycle growth curves were computed using the formula developed by H. Heinis, and multi-cycle equations were written using the Courtis technique.

Average deviations were obtained for each method on each case between the score actually obtained on the test and the derived theoretical score. Frequency distributions were drawn of the average deviations, and tests of statistical significance were made to compare the mean average deviation of each of the three methods. A mean average deviation of 4.7 months was found for mental test data described by multi-cycle equations, while mean deviations of 7.4 months and 8.2 months were found for single cycle and straight line methods of description. The difference between the mean average deviation found in writing multi-cycle equations was significantly lower, at the one percent level of confidence, than the mean average deviation of the other two methods.

A comparison of the mean average deviations obtained during the same ten-month period of chronological age showed that both the straight line and the single cycle methods of describing growth showed a statistically significant increase after 160 months of age, while the mean average deviations obtained by the multi-cycle method during each ten month interval was relatively constant.

It was concluded that the mental growth pattern shown by the actual test scores of an individual are more nearly described by multi-cycle growth equations than by either a single cycle or a straight line growth equation.

Microfilm \$2.00; Xerox \$5.00. 113 pages.

THE DEVELOPMENT OF A CRITERION OF THEORETICAL SIGNIFICANCE FOR EDUCATIONAL SCIENTISTS

(L. C. Card No. Mic 59-2014)

Richard Luther Derr, Ed.D.
University of Illinois, 1959

The purpose of this investigation was to develop a criterion which would encourage the use of theoretically significant concepts in educational science. Educators have not developed such a criterion. Therefore, we began with a version of a criterion formulated in the natural and social sciences. According to this version, concepts are theoretically significant if they facilitate the development of theories and laws. We concluded that this formulation could not be profitably used by educational scientists because the matter of the nature and major kinds of significant laws and theories in educational science has not yet been settled.

The study then took the form of an attempt to settle this matter. The starting point was given by the fact that

educational science is an applied science. It is applied to the problems of organized education. With this in mind, we set out to discover the basic task of organized education. We concluded that it was to control the personality development of students. Hence, we drew the inference that significant laws and theories in educational science were those which helped educational practitioners to control personality development in students. Moreover, we could then say that concepts are theoretically significant in educational science if they facilitate the development of such laws and theories. Two analyses were undertaken to determine the major kinds of significant laws and theories. First, we isolated those generalized conditions which must obtain if practitioners are to control personality development. Second, we determined the major categories of empirical conditions which affect the possibility of controlling personality development. The result of these analyses was the development of a paradigm which specified the three major kinds of significant laws and theories in educational science. Such a paradigm represents an auxiliary device which is to be used in conjunction with the criterion.

Our own version of the criterion was then reformulated to correct two serious weaknesses. First, it failed to provide a workable index which educational scientists could use to determine whether or not the concepts had actually facilitated the development of significant theories and laws. This weakness was corrected by the isolation of a stage in the processes of theory-building and law-discovering which is frequently reached by educational scientists, i.e., the stage of hypothesis-construction. Reference to this stage was then incorporated into the final version of the criterion. Second, the amplified version of the criterion was not sufficiently precise. This weakness was corrected by including in the criterion a requirement that the theoretical significance of the concept in question must be demonstrated. The final version of the criterion was stated as follows: concepts are theoretically significant if they are shown to generate significant hypotheses. Again, the paradigm represents a necessary auxiliary device. We concluded that the criterion was adequate in this form.

An analysis of the concepts of general methods of teaching was conducted to demonstrate the adequacy of the criterion. Two significant hypotheses were generated.

It was pointed out that we could not conclusively evaluate the fruitfulness of the criterion and paradigm, i.e., their actual capacity to solve educational problems, since this is an empirical matter. However, we argued that this could be approximated if it could be shown that they provide a basis for re-orienting the theoretical and empirical approach to an important but unsolved educational problem and to educational problems in general. Our analysis of the general methods of teaching suggested the manner in which such a re-orientation could be effected.

Microfilm \$2.00; Xerox \$5.60. 115 pages.

A COMPARISON BETWEEN SPONSORED AND EDUCATIONAL MOTION PICTURES: A STUDY OF HIGH SCHOOL BIOLOGY FILMS ISSUED IN THE UNITED STATES IN 1955

(L. C. Card No. Mic 59-1054)

John Louis Fell, Ph.D.
New York University, 1959

Chairman: Professor Charles A. Siepmann

The Problem

The purpose of this investigation was to compare a selected set of industrially sponsored, school used motion pictures with a selected art of educational films. All films examined were first issued in the United States in 1955 and might be considered appropriate to high school biology courses by way of their titular designations and their film catalogue categories and descriptions.

Procedures in Collecting and Treating Data

A search in the available literature pertaining to sponsored and school used motion pictures provided a general listing of film characteristics which are common among motion pictures used in the classroom and which might be measured and evaluated in terms of educational criteria, cinematic qualities and advertising devices. These characteristics were so prepared that their evaluations might be expressed in quantified terms. The evaluation techniques were validated by demonstrating an 80 to 100 per cent coincidence of like responses between the researcher and an independent reviewer to a sample of five films.

Seventy-nine per cent of the films solicited were secured: twelve educational titles and nineteen sponsored films. Thirty-six film characteristics in each motion picture were evaluated by the investigator, and eight more items - specifically concerned with biological matters - were evaluated by a qualified biology consultant.

The quantified results of the evaluations were translated into two by two tables. Their characters were expressed as probability measurements by way of a Chi Square formula, Fisher's Exact Probability Test of a formula for the comparison of two proportions.

Attention was directed to those comparisons which showed a probability value of .20 or less, with increasing interest devoted to the smaller *P* scores.

Findings

The investigation noted thirteen film characteristics which evidenced a significant-tending difference between the sponsored and the educational motion pictures. Twelve of these differences suggested that the educational films were the more appropriate to high school biology classes and pedagogically more acceptable (as defined by the criteria of the film characteristics which had been imposed). It was further concluded by way of these significant-tending differences that the educational films were better executed examples of effective motion picture technique. The findings on promotional and sales appearances in the sponsored films were evaluated against both industry-derived and educationally - derived criteria of "good" procedure. It was concluded that by any of these measures, obvious forms of sales promotion - where they existed in sponsored films - were far more than minimal.

Microfilm \$2.00; Xerox \$6.00. 123 pages.

**A STUDY OF PROCEDURES IN MEETINGS OF THE
DIVISION OF EDUCATION IN A STATE TEACHERS
COLLEGE WITHIN A FRAMEWORK OF EXPRESSED
PREFERENCE FOR DEMOCRATIC GROUP PROCESS**

(L. C. Card No. Mic 59-2534)

Frances M. McKee, Ed.D.
University of Maryland, 1958

Supervisor: Professor Madelaine Mershon

Purpose

The purpose of this study was to observe and record procedures and sequence of events in group meetings of the division of education in a state teachers college within a framework of expressed preference for democratic group process. The researcher was granted permission by administrators and group members, including official status leaders of the division in which the study was made, to observe and record procedures and sequence of events in group meetings. Ultimate objectives of the participant-observer were to examine the records of group meetings, study specifically selected literature in the field which contained criteria, or the approximation of criteria, and to make cautious, qualitative interpretation on the basis of the researcher's present best insights and understandings.

Procedure

Data relevant to the expressed purpose of the study were collected by the participant-observer during the academic year 1953-1954. Data included the following materials: records of participant-observer for twenty group meetings of the division of education-staff of the laboratory school, official minutes of meetings recorded by the elected secretary, weekly bulletins issued by the division of education chairman and the principal of the laboratory school.

Classifying and analyzing the data included the following steps: (1) the researcher made a trial run of the data from the collected records for September-October and April-May periods, (2) the researcher underlined items of experience which appeared to be significant in relation to the expressed purposes of the study, (3) the researcher then listed items of experience for the purpose of studying procedures and sequence of events in meetings and for noting continuity from one meeting to another throughout the year, (4) trial run results were examined for the presence of significant items relevant to objectives of the study, (5) likes, or similarities, were listed by the researcher with a view to seeing patternings which might recur and continue to recur throughout the data. Results of first processing of the data appeared judgmental; therefore procedures were repeated with increased emphasis upon the framework and purpose of the study. The technique employed was that which is present in research studies of the Institute for Child Study, University of Maryland: considering those like behaviors which occurred more than twice and following them through the processed data to note their recurrence through the time of the study.

Observed patternings were considered in relation to specifically relevant writings of respected authorities in areas of group process. These writings were viewed as constituting or approximating criteria. Interpretations were drawn, tentatively, from consideration of Chapters I through V of the thesis. Implications within the expressed limits of the study were examined. Interpretation and summary were set forth in Chapter VI.

Findings

Observed patternings in procedures and sequence of events in meetings of the division of education interpreted to be in accord with statements of respected authorities in specifically related areas--and thus to be trends in the direction toward democratic group process--were climate before and during meetings, and some aspects of official status leader functioning, structure and sequence of events in meetings, and group process.

Observed patternings interpreted not to be in accord with statements of respected authorities in specifically related areas--and thus to be trends in direction away from democratic group process--were some aspects of official status leader functioning, structure and sequence of events in meetings, and group process.

Areas interpreted as suggesting need for further study were: participation in initial planning by individuals affected by policy and action decisions, evaluative procedures, effective use of records, agenda planning, implementing group-derived decisions, and aspects of official status leader functioning.

Microfilm \$2.20; Xerox \$7.80. 168 pages.

**FIFTH-GRADE PUPILS' UNDERSTANDING OF TERMS
ENCOUNTERED IN THEIR SOCIAL STUDIES TEXTS**

(L. C. Card No. Mic 59-2040)

George Henry Millis, Ed.D.
University of Illinois, 1959

Sixty-five fifth-grade pupils in a southern Wisconsin community were asked to express orally their understanding of twenty social studies terms. The pupils were interviewed during the first two weeks in December, 1957. The terms were chosen by random selection from among sixty-one that had been emphasized in the basic text the pupils had read during the first three months of the school year. In order that they might be examined, the pupils' responses were tape recorded and then transcribed.

The responses were classified in four categories as follows:

- A--In the judgment of the investigator the response of the child indicates that the child has an understanding of the term corresponding to (or superior to) that intended by the author of the text.
- B--In the judgment of the investigator the response of the child indicates that the child's understanding of the term is partially correct or is vague and indefinite.
- C--In the judgment of the investigator the response of the child indicates that the child's understanding of the term is incorrect. The child's response does not indicate that he understands the term, or indicates that he misunderstands the term.
- D--The child gave no answer or answered, "I don't know."

It was found that five hundred three of the responses, or 38-7/10 per cent, could be classified in category A. Four hundred thirty-nine, or 33-8/10 per cent, could be classified in category B. Two hundred twenty-two, or 17-1/10 per cent, could be classified in category C. One

hundred thirty-six, or 10-5/10 per cent, could be classified in category D.

Each pupil was given a score that represented his total understanding, as expressed by his oral responses, of the twenty social studies terms. The distribution of these scores for all sixty-five pupils was correlated with various other factors. The resulting correlation coefficients were found to be as follows: mental age, $r = .60$; reading comprehension, $r = .60$; reading vocabulary, $r = .50$; sex, $r = .28$; and chronological age, $r = .05$. However, the highest correlations were found to be with the various sub-tests of a social studies achievement test. These correlations ranged from $r = .48$ to $r = .79$.

Marks the sixty-five pupils received on their report cards seemed to be related to understanding of social studies terms only in a general way. Forty-six pupils received A's or B's on their report cards. Of these, nineteen were below the median of the social studies terms score distribution. Of the nineteen, nine were more than one quartile deviation below the median.

The misconceptions the children held (indicated by category C responses) were classified in five types. It was found that the percentage of each type of misconception increased as the intelligence level decreased. The percentage of "don't know" responses (category D) also increased as the intelligence level decreased.

If pupils are to develop a more complete understanding of the terms encountered in their social studies texts, it would seem that authors would need to use the terms in more instances than were encountered by the pupils in this study. It would also seem that the terms should be explained more completely. In addition, teachers should not expect that pupils will have understood a term merely through reading about it in the text. They need to provide additional experiences in the classroom in order that pupils may learn the term through the use of it.

Microfilm \$2.00; Xerox \$5.60. 115 pages.

FACTOR ANALYSES OF THREE TESTS OF CRITICAL THINKING

(L. C. Card No. Mic 59-2055)

Velma Irene Rust, Ph.D.
University of Illinois, 1959

This study was initiated as a result of the findings of the Illinois Curriculum Program Committee relative to its Critical Thinking Project. The Committee obtained low intercorrelations between scores on any two of the following tests: the Watson-Glaser Critical Thinking Appraisal, Form Bm, A Test of Critical Thinking, Form G, prepared by the American Council on Education, and A Test on Principles of Critical Thinking, Form F1.5, prepared by the Project staff. These low intercorrelations led to the inference that there is little relationship between knowledge of the principles of critical thinking and the ability to use these principles. The Project Committee then felt the need for more information regarding the internal structure of the three critical thinking tests.

The technique of factor analysis was used to test the following research hypothesis: A factor analysis of the items of each of the three tests of critical thinking will

show that the tests measure the same skills and abilities, or, in other words, Factor analyses of these three tests of critical thinking will yield some common factors among the items of these three tests.

The objectives of the study were threefold: (1) to study each test individually in order to check the a priori reasoning of the makers of the tests regarding appropriate grouping of items; (2) to plan a factor analysis of a composite test made up of selected items from all three tests for the purpose of ascertaining whether or not the three tests measure the same skills and abilities; and (3) to improve the Test on Principles or to enable a new test to be developed.

From nearly three thousand students involved in the original Critical Thinking Project, 587 students were selected on the basis of having attempted all items on all three tests. This sampling technique did not create bias with respect to intelligence or achievement. The factor analyses yielded only one weak general factor for each of the three tests. At this point it was decided nothing could be gained by attempting to rotate to oblique simple structure, or by factor analysis of a composite test. It was believed that there was little likelihood of finding any strong factors common to all three tests.

Logical analyses of the tests revealed that, to some extent, the test makers emphasize different aspects of critical thinking in their tests. Mean item difficulties for the tests were found to be: Watson-Glaser, 0.66; ACE, 0.67; and Principles, 0.51. On the whole, inter-item phi correlation coefficients were low. The first centroid factor for each of the three tests accounted for only a small portion of the variance, in all cases less than fifteen per cent. It was, therefore, of little value in explaining the intercorrelations of test items within the test. Thus, very little parsimony was obtained insofar as describing the internal structure of each test in simple terms is concerned.

All these findings indicate that only in rare instances was the a priori reasoning of the test makers regarding grouping of items confirmed. This suggests that all items within a subtest do not measure the same skills or abilities, and therefore do not measure the skills or abilities they were intended to measure (according to subtest titles and/or the manual accompanying the test). The author concludes that the tests are somewhat less than perfect as evaluative instruments and thus need to be improved.

Microfilm \$2.00; Xerox \$6.40. 131 pages.

STUDENT DISCOVERY OF ALGEBRAIC PRINCIPLES AS A MEANS OF DEVELOPING ABILITY TO GENERALIZE

(L. C. Card No. Mic 59-2318)

Oscar Frederick Schaaf, Ph.D.
The Ohio State University, 1954

One problem confronting secondary schools is the determination of a suitable mathematics program for students in the ninth grade. This problem becomes more acute when all ninth grade students are enrolled in the same mathematics class. In such a case it is important that both the content and the methods of teaching have a wealth of educational value for all students. The task of the dissertation is to present such a single mathematics course which has

as its central theme the development of students' ability to generalize.

The proposed program is an outgrowth of experimental investigation into the teaching of algebra at the University School, the Ohio State University. Instructional procedures were such as to encourage students to extend their previously acquired mathematical principles, and to discover new algebraic principles from their present and past experiences. Throughout the course, emphasis is placed on student discovery. The teacher's role is to organize material and to direct class thinking so that the students can discover generalizations. He also has the responsibility for guiding students to a realization that essentially the same method is used in forming generalizations in other areas of learning that is used in forming generalizations in mathematics.

The mathematical content of the course was selected so as to accomplish four objectives:

1. The illustration of various generalizing procedures
2. The presentation of an overview of mathematics and a discussion of the interrelatedness of its many branches
3. The inclusion of topics the students make use of now and most likely will use in the future
4. The review and extension of arithmetic understandings

Although these criteria are used as a basis of selection, no organized attempt is made to determine which content most closely adheres to them. The primary concern in this study is the teaching procedures used in presenting the content to the students.

In the development of this course, the following tasks were assumed to be the most significant:

1. Analyzing the different processes of generalizing and determining the characteristics of a superior generalizer
2. Designing lesson sheets and other procedures which can be used in aiding students to develop their ability to generalize in both mathematical and non-mathematical situations
3. Evaluating in terms of the characteristics of a superior generalizer any improvement made by students enrolled in the experimental class
4. Evaluating the mathematical achievement of the experimental class

A measure of the improvement made by the experimental students in their ability to generalize was obtained from the results of a generalization test given at the beginning and end of the school year. Since it is possible that any change the experimental students might undergo could be the result of their normal maturation, the generalization test was also given at approximately the same time to a group of algebra students from several algebra classes in the Columbus public schools. In this study this group of students is referred to as the status group. Conclusions concerning the effectiveness of the teaching procedures in the development of generalizing abilities are then made in terms of the test results from both groups of students. Other sources of data for evaluating the experimental course¹ were observer reports, student notebooks, the writer's notes concerning each class meeting, and

responses on student reaction sheets. A measure of the mastery of mathematics is also judged in terms of tests given the experimental and public school classes at the beginning and end of the years.

The improvement of generalizing ability is an objective which is consistent with the aims and purposes of the University School and important from the standpoint of understanding mathematics. Improvement in both the discovery and proof of generalizations is important in furthering the ability to generalize, but of the two the former is of greater concern in this experimental course. Ways by which generalizations are discovered are stated below:

Empirical generalization suggested by

- a. Simple enumeration
- b. Analogy
- c. Continuity of form
- d. Statistical procedures

Rational generalization suggested by

- a. Deduction
- b. Variation
- c. Formal analogy
- d. Inverse deduction

A superior generalizer is assumed to be a person who is able to use all these procedures in arriving at generalizations. An analysis of all these procedures reveals that the superior generalizer should have the following abilities and behaviors:

1. He is able to detect likenesses and differences between situations and then to group together those situations which possess common properties.
2. He is able to correctly generalize with certainty where certainty is justified, but refrains from generalizing when it is unwarranted.
3. He is able to determine trends from available data and make reasonable extrapolations and interpolations from them.
4. He is cautious in accepting generalizations, but is willing to consider any generalization as a hypothesis.
5. He can distinguish generalizations from observable facts.
6. He uses generalizing methods independently to further his understanding of the world around him.
7. He makes use of generalization which he senses through nonverbal means.
8. He is able to verbalize generalizations and methods used in discovering generalizations.
9. He continually searches for examples which are exceptions to formulated generalizations and then reformulates them to include the exceptions.
10. He investigates implications of generalizations under consideration.
11. He searches for explanations for generalizations discovered empirically.
12. He empirically tests or searches for an increasing number of applications to generalizations that have been suggested by rational procedures.

13. He searches for and recognizes relevant factors responsible for happenings or for the behavior of objects in certain situations.
14. He studies accepted generalizations from as many points of view as possible.
15. He uses statistical measures in making generalizations.

The lesson sheets studied by the experimental class included content which can be summarized under the following headings:

- a. Number and Operation
- b. Graphs and Formulas
- c. Equations and Problem Solving
- d. Proportion and Indirect Measurement
- e. Statistics

The success of any experiment depends upon how well the data collected answer basic questions concerning the main objective of the experiment. The conclusions suggested by the data collected in this experiment are listed under the basic question they help to answer.

How well did the content lend itself to student discovery procedures, thereby giving students practice in generalizing?

1. Teaching procedures can be organized so the average student can make use of generalizing procedures in the discovery of algebraic principles and concepts.

2. The combination of algebraic content and student discovery teaching procedures as used in the experimental class did offer excellent opportunities for students to develop the behaviors and abilities characteristic of a superior generalizer.

Did the experimental class when compared with the status group actually make significant improvement in their ability to generalize?

3. The experimental class made significantly greater improvement in their ability to draw conclusions that are justifiable extrapolations and interpolations of accepted data.

4. The experimental class made significantly more improvement in their ability to recognize conclusions that were not justifiable extrapolations and interpolations of accepted data.

5. The experimental class became noticeably more discreet in their use of caution when generalizing from data that is relatively independent of the climate of opinion.

6. The experimental class also appeared to become more discreet in their use of caution when generalizing from data originating from the surrounding climate of opinion.

7. The experimental class made significantly greater improvement in interpreting graphical and tabular data.

8. The teaching procedures used in the experimental class did help students in developing their ability to generalize in nonmathematical situations (according to the generalization test given at the beginning and end of the year).

How well did the experimental class master algebra?

9. The experimental class achievement as measured by results on the Ohio Every Pupil Test was accurately predicted by results on the Iowa Algebra Aptitude Test. Their achievement as measured by the Lankton First Year Algebra Test was significantly greater than was predicted by the results on the Iowa Algebra Aptitude Test. This

achievement was accomplished even though these students had much less school time for the study of algebra than did the students in the public school classes.

What were students' reaction to student discovery and emphasis upon generalizing?

10. At the beginning of the year student discovery procedures and the emphasis on generalizing should be introduced slowly. Apparently students have to live with and gain confidence in such teaching procedures before they see their worth.

11. If students sense they are making progress in the discovery of a generalization, their reaction to student discovery procedures is highly favorable.

12. Successful use of student discovery gives students considerable satisfaction.

13. By the end of the year a large percentage of the students liked the emphasis on student discovery, and the class at large felt the emphasis on generalizing was desirable.

14. Student discovery procedures can arouse students emotionally. This is especially noticeable whenever some generalization result contradicts a preconceived notion of what they expected to find. An example of such a generalization is the rule for multiplying two negative numbers.

15. The success of student discovery procedures on any particular day is more dependent than other procedures upon the general emotional tenor of the class.

How well do student discovery procedures take into account certain pedagogical considerations assumed to be of major importance?

16. Students in the experimental course were provided opportunities in which they, as a natural consequence, did think for themselves, and some even did seek knowledge independently.

17. The role of the teacher in student discovery procedures is an important one. He must organize materials well enough so that students can see they are making progress in the discovery of generalizations, but not so well that there are no discoveries of any consequence for them to make.

18. Student discovery procedures, as used in the experimental class, offered many opportunities for an intelligent application of the principles discovered and greatly reduced the opportunities for students to apply a principle mechanically.

19. The use of student discovery procedures in the discovery of algebraic principles provides many opportunities in which students as a natural consequence think intelligently with symbols and become aware of the role of symbols in the discovery of ideas and thinking in general.

20. The successful use of student discovery in the teaching of algebraic principles requires that the teacher remain close to the understanding of his students.

21. Student discovery procedures enable the teacher to employ a wide range of desirable motivating devices and techniques.

22. The employment of student discovery procedures encourages students to strike out on their own in the discovery of new ideas, thus helping to make the course flexible enough to allow for a wide range of abilities and purposes.

23. Student discovery of algebraic principles almost of a necessity requires emphasis on generalizing procedures and on application. This emphasis in turn increase the chances that the concepts and procedures learned will transfer.

What are other conclusions that can be made from this study?

24. Student reaction to the content studied indicated that probably less time should have been spent on factoring, special products, and algebraic fractions, and probably more time spent on the study of ratio and proportion, indirect measurement, and statistics.

25. Students were more generalization conscious at the end of the year than at the beginning.

Taking all the evidence into consideration the conclusion can be drawn that the use of student discovery procedures in the experimental course significantly improved the students' ability to generalize in both mathematical and non-mathematical situations and, at the same time, allowed them to gain a reasonable mastery of algebraic principles.

Microfilm \$5.70; Xerox \$20.00. 447 pages.

1. These other sources do not include data from the status group.

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VALUE-CLARIFICATION: METHODOLOGY AND TESTS OF AN HYPOTHESIS IN AN IN-SERVICE PROGRAM RELATING TO BEHAVIORAL CHANGES IN SECONDARY SCHOOL STUDENTS

(L. C. Card No. Mic 59-1049)

Sidney B. Simon, Ed.D.
New York University, 1958

Chairman: Professor Louis E. Rath

The general purpose of this investigation was to inquire into the relationships between a value-clarification methodology concept and a concept of value-related behavior problems. The behavior problems of the experimental children were seen as the products of a confusion in values, a conflict in values or an absence of value formation, which in turn was related to the complexity, confusion and conflict within our culture.

It was hypothesized that as the experimental children's values were clarified, the behavior of these children would undergo certain self-directed changes. The experimental children were to be described as accurately as possible in the beginning of the study, the value-clarification methodology was to be applied to them, and then they were to be carefully described again at the end of the study.

The value-clarification methodology was taught to the experimental teachers during fifteen weeks of an in-service training program which was a vital part of this action research project. Each teacher in the in-service program worked with a student who had a value-related behavior problem, attempted to have at least one conversation with the child she was studying on each school day, and recorded the content of each of these conversations on a daily report form. These reports which reflected the application of the value-clarification methodology were part of the raw data for this study. At the end of the study, two independent judges were enlisted to go over each teacher's total accumulation of the daily reports of the conversations held with each experimental child and these were evaluated in

terms of a seven point scale to determine to what degree the teachers actually applied the value-clarification methodology.

It is difficult to describe the value-clarification methodology without citing many examples of what a teacher says to a student and what a student says to the teacher. Suffice it to say that the value-clarification methodology involves a series of searching questions which focus upon the value areas in the life of the student questioned. Value-clarification, however, does not involve an interview, and it is not counseling or therapy. Rather it is seen as a classroom teaching technique in which the teacher does not attempt to impart a specific set of values, but instead helps the student to find what it is he values.

The methodology has certain identifiable aspects, among which are these: (1) the teacher applying the value-clarification methodology tends to ask questions which are related to areas of major concern to the student, i.e.; the student's attitudes, beliefs, interests, thoughts, feelings, activities, purposes and aspirations; (2) the teacher asks questions which make use of the fourteen clarification operations evolved by Professor Louis E. Rath of New York University. Typical questions include: "Is this what you mean?" "Do I understand that you're saying...?" "What plans have you made?" "Is this a good thing?" "Where does it lead?" "What's blocking you?" "How can I help?" (3) the teacher tends to ask questions to which she does not already have an answer in mind; (4) the teacher asks questions which explore value-type responses in terms of the five parts of a definition of a value used in this study. She explores it in terms of: whether the student's response is prized or cherished; whether it is part of a pattern; whether it is chosen as a free choice after due reflection and from among alternatives; whether it is affirmed when said back to the person making the value-type statement; and whether or not it has entered into the person's life and some consequent action has been taken upon it. The value theory supporting this study and the definition of values growing from it stem mainly from the work in values done by John Dewey and Louis Rath.

The study made use of a comparison group of children having similar behavior problems but with whom the value-clarification methodology was not employed.

Data were collected relating to the two concepts under test; the value-clarification concept and the value-related behavior problem concept. The conclusions of the study are cast in confusion. Although eight of the ten experimental children in the study manifested less of their original undesirable behavior, only one child underwent changes which were sweeping, dramatic and recognized widely by other teachers in the school. Furthermore, only one of the teachers, according to the ratings of the independent judges, demonstrated an effective application of the value-clarification methodology. To compound the confusion, the three teachers who achieved the lowest rank on the rating scale brought about changes in the children they studied, while two other teachers who made higher ratings on the scale did not report changes in the children they studied. Thus, the hypothesis has not been supported. On the other hand, the value-clarification methodology has not been disproved either. It needs to be set to other relationships and in other hypotheses.

When the results of a study are confused, which is the case with this one, the study often raises more questions than it answers. Important questions have been posed in

this study which relate to the present nature of the secondary schools in this study and to the limited role the secondary teachers were willing to assume for the growth of the students in their care. Many of our secondary school teachers have difficulty in working with individuals and prefer teaching in terms of "classes." Furthermore, they frequently believe that behavior problems are the concern of the guidance counselors or the vice-principal in charge of discipline. Another difficulty the secondary teachers had in applying the value-clarification methodology was expressed in these teachers' seeming inability to relate their subject matter areas to the concerns of their students; to their students' attitudes, beliefs, thoughts, feelings, activities, interests, purposes or aspirations.

The problems the value-clarification idea focus upon persist and are important ones indeed. The confusion and conflict within our culture create many personal problems for the individuals in search of values. Frequently the conflict and confusion are expressed in undesirable behavior such as that of the students who were the subjects of this study. Further research is needed to explore what can be done for students who are conscious under-achievers, extremely indecisive, over-conforming to the teacher or who express other value-related behavior. More research is needed, too, to explore the place of a value-clarification methodology as one way of helping people towards a stable value-system.

Microfilm \$4.60; Xerox \$15.40. 358 pages.

THE DIFFERENTIAL CONTRIBUTION OF SPECIFIC WORD RECOGNITION TECHNIQUES TO READING ABILITY AT VARIOUS LEVELS OF EDUCATIONAL ADVANCEMENT

(Publication No. 20,535)

Helen Amalia Strand, Ph.D.
University of Minnesota, 1956

This cross-sectional study was designed to investigate whether there were differences with regard to specific word recognition skills between pupils who were over-achievers and under-achievers in reading comprehension. Information used was collected in the Austin, Minnesota public schools during the 1950-1951 school year. The study was planned to test the several hypotheses that there was no difference in means on tests of ten word recognition skills between pupils who over- and under-achieved in reading comprehension.

Tests used in the collection of data were: California Test of Mental Maturity -- Non-language Section, Primary and Elementary Series; Gates Primary Reading Tests,

Types 1 and 3; Gates Advanced Primary Reading Tests, Types 1 and 2; Gates Basic Reading Tests, Types A, B, C, and D; Silent Reading Diagnostic Test, 1950 Experimental Form.

Of the 792 pupils in grades two, three, and four completing all the above tests, 430 were used in the statistical analysis. Boys and girls were studied separately in each grade.

Regression equations were used to predict reading scores from mental age. For each grade-sex group, the twenty-seven percent whose actual reading comprehension scores were in greatest excess of predicted scores were classified as over-achievers; the twenty-seven percent farthest below predicted scores were classified as under-achievers.

For sub-tests of the diagnostic reading test on which various were homogeneous, the significance of the difference between over- and under-achiever means was tested by analysis of variance. For other sub-tests, differences between means were tested by the Behrens-Fisher test.

Hypothesis were rejected if differences in means were significant at the .01 level or below. Differences significant between the .01 and .05 levels were considered doubtful and as needing further research to be proved or refuted.

The hypothesis of no difference between means of over-achievers and under-achievers was rejected for both boys and girls in grades two, three, and four on the following tests of word recognition skills: recognition of words in isolation, recognition of reversible words in context, locating elements, word synthesis, knowledge of beginning sounds, knowledge of rhyming sounds, knowledge of word elements, syllabication, locating root word.

This hypothesis was rejected for knowledge of letter sounds for second and third grade boys and for second grade girls. Results were in the region of doubt for grade four boys and grade three girls, but for grade four girls the hypothesis was accepted.

Although mental age was controlled thus making over- and under-achieving groups similar in mental ability, for any grade-sex group on any test of word recognition skills, the over-achievers had the higher mean score.

Among the educational implication of this study, the following may be noted. Average or above average mental ability is not of itself a guarantee of reading success. Higher means scores at successive grade levels seem to indicate that improvement in word recognition skills continues to develop at successively higher grades. Knowledge of word recognition skills is related to successful achievement in reading but it provides no guarantee of such achievement. Knowledge of letter sounds was the only element of word recognition studies that did not maintain a determining role in reading success at the higher grade levels.

Microfilm \$2.80; Xerox \$9.60. 215 pages. Mic 59-2787

ENGINEERING

ENGINEERING, AGRICULTURAL

A STUDY OF WATER FLOW PATTERNS NEAR SUBSURFACE DRAINS

(L. C. Card No. Mic 59-2042)

Edwin John Monke, Ph.D.
University of Illinois, 1959

Flow of water near subsurface drains as with all soil drainage is subject to the conservation of fluid mass and energy which can be expressed for a two dimensional system by Laplace's equation as

$$\partial^2 \Phi / \partial x^2 + \partial^2 \Phi / \partial y^2 = 0$$

where Φ is the work done on a unit mass of water in moving it from a reference point to any point in question.

Previous mathematical solutions for flow into circular subsurface drains have been approximate especially in the soil region near the drain; because in order to make the solution tractable, the drain has been considered as a point sink. Furthermore, the dynamic condition within the drain has been ignored since the potential (hydraulic head) at the periphery of a drain opening has been assumed constant in order to stabilize boundary conditions for mathematical solution.

In this study, the water level in the drain was a variable and hence other means than mathematical were sought for the solution of the Laplace type drainage equation. Potential values throughout given drainage regions were found by numerical approximation, by flow analogies, and by direct hydraulic head measurements in drainage models. Once the loci of equal values were found, the flow pattern being orthogonal to them was adequately described.

The effect of a change in water level in a drain from nearly empty to full flow was evaluated for a practical subsurface drainage system using finite-difference approximations. Variation of boundary conditions within a five inch circular drain was undetectable in potential values obtained 1.5 feet from the drain.

Flow of water in a porous medium is analogous to the flow of electricity through a conducting substance. Comparison of Ohm's and Darcy's laws shows that the quantity of transported matter, electricity and fluid, respectively, is proportional to a driving force, and that the constant of proportionality is in both cases some physical characteristic of the transport medium. Potential values were obtained with a vacuum tube voltmeter in a water bath representing a porous medium being an assumed or calculated outer boundary and a simulated surface of seepage representing an inlet into a circular drain. An electrical analogue was used because boundary conditions were more easily changed and a more homogeneous medium was obtained than with a physical model. Plotted results demonstrated that flow lines were slightly spiraled into the simulated nearly empty drain and acutely intersected the surface of seepage.

Quantitative flow results were obtained from a circular physical model and then checked with an electrical analogue. When the radial symmetry of the model was disturbed by lowering the water level in the drain, approximately 60 percent of the gain in head was used just to maintain the same drain discharge which was obtained when the 5 inch drain was flowing full. In a practical drainage situation, however, where the distance from the drain to the impermeable layer was relatively large, the percentage gain in discharge was slightly larger than the corresponding gain in hydraulic head.

The combined results of the three independent methods of study also showed that (1) the flow along a surface of seepage which forms within agricultural drains when they empty can be analyzed similarly to flow through the porous medium, (2) the head loss at a drain opening depends in part on the hydraulic conductivity of the flow medium, and (3) partially blocked circumferential drain openings can depress drain discharge more than would be predicted from the reduction of opening sizes.

Microfilm \$2.15; Xerox \$7.60. 161 pages.

AIR FLOW ANALYSIS OF GRAIN VENTILATION DUCTS

(L. C. Card No. Mic 59-2424)

Gene Clere Shove, Ph.D.
Iowa State College, 1959

Supervisors: William V. Hukill and Glenn Murphy

A study was conducted to establish a relationship between air intake or discharge and the static pressure gradient along a perforated duct as applied specifically to the selection and design of grain ventilation ducts. From analytical considerations and experimental results an expression for predicting the static pressure gradient in a perforated duct was developed. The results of the study indicate the rate of static pressure change in a perforated grain ventilation duct can be expressed as a constant times the rate of velocity head change algebraically added to the rate of friction head change. Analytically the value of the constant applied to the rate of velocity head change will be the same for both combining and dividing flow systems; however, the experimental results of this study indicated the value of the constant for dividing flow can be expected to be less than the constant for combining flow. For combining flow the constant applied to the rate of velocity head change was found to be equal to 1.70 and for dividing flow 1.50 for the 5-inch diameter perforated duct used in the experimental tests.

Both combining and dividing flow systems were considered since both systems are used in grain ventilation. In a combining flow system the static pressure change

associated with velocity change and the static pressure change associated with friction both cause a decrease in the static pressure gradient in the direction of flow. In a dividing flow system the static pressure change associated with velocity change tends to offset the static pressure change associated with friction. This effect is referred to as static pressure regain. The relative value of the static pressure regain and duct friction loss will determine whether the static pressure for dividing flow will decrease, increase, or remain constant along the length of the duct.

Examples demonstrate how the results of the study can be combined with available information relating static pressure to air flow through perforated metal sheets and through grain in the design of grain ventilation ducts to provide a selected air intake or discharge along the length of the duct. The results may have application to the design of perforated ducts for purposes other than grain ventilation. Microfilm \$2.00; Xerox \$5.60. 115 pages.

ENGINEERING, AERONAUTICAL

CREEP BUCKLING OF THIN CIRCULAR CYLINDRICAL SHELLS

(L. C. Card No. Mic 59-1772)

Francis William French, Jr., D.Ae.E.
Polytechnic Institute of Brooklyn, 1959

Advisers: N. J. Hoff and Joseph Kempner

The behavior of thin circular cylindrical shells, loaded by axial compression or by pure bending and in the presence of creep, is investigated.

For the case of pure bending, the study is carried out by means of experiment and theory. A high temperature testing apparatus was designed and constructed specifically for the testing program and is described in detail. The experiments investigate the effects of sheet thickness, cylinder length, bending moment, and the number, type, and distribution of reinforcing elements on the creep lifetime of the specimens. The results of 102 experiments are given in photographs, curves, and tables.

The theoretical part of the bending investigation is concerned with a simplification of an existing theory by the use of experimental results. The developments leading up to Hoff's theory of creep buckling by flattening are traced. The two simultaneous differential equations obtained by Hoff are simplified with the result that the useful lifetime of the cylinder is defined by a simple algebraic expression. This simplified theory is compared to Hoff's theory and to experiments by means of numerical examples. Curves are presented to implement the comparison. A method for calculating the elastic curvature and flattening is proposed and the effect of instantaneous inelastic deformations on the creep strength is discussed in an appendix.

For the case of axial compression, the study is carried out by theoretical means. It is assumed that the deformations are axially symmetric and that the actual shell may be represented by an ideal sandwich shell. A biaxial creep law is used and the lifetime of the cylinder is obtained from

the numerical integration of two simultaneous differential equations. Numerical examples are carried out and the results are presented in the form of curves.

Microfilm \$2.00; Xerox \$5.00. 99 pages.

SKIN FRICTION AND HEAT TRANSFER STUDIES AT SUPERSONIC SPEEDS FOR TURBULENT BOUNDARY LAYERS

(L. C. Card No. Mic 59-2485)

John Loomis Harkness, Ph.D.
The University of Texas, 1959

Supervisor: Dr. M. J. Thompson

The results of an experimental and theoretical investigation concerning turbulent skin friction and heat transfer rates are presented for the case of supersonic flow over a zero pressure gradient isothermal surface. The first phase of the work concerns an experimental investigation of the heat transfer rates on a flat plate model at a nominal Mach Number of 5.0. The second phase of the work concerns a theoretical analysis of the heat transfer and skin friction problem, based on the mixing length concept.

The experimental program was conducted in the 6 x 7-inch high stagnation temperature supersonic wind tunnel of the Defense Research Laboratory, The University of Texas. This tunnel is a "blowdown" type facility producing intermittent supersonic flows up to two and one-half minutes in duration, with supply temperatures to 1000°F. A flat plate heat transfer model, 6 x 15 inches in size, was designed, constructed and tested in the DRL tunnel at a nominal Mach Number of 5.0. The model provided for the use of an internal coolant, and boiling water was used in order to maintain a constant internal surface temperature. Heat transfer rates were obtained by recording equilibrium temperatures of the external surface and the internal cooled surface.

Basically, four sets of data were obtained with the ratio of the wall temperature to the ambient free-stream temperature varying from 3.51 to 4.47. These various degrees of heat transfer were attained by changing the stagnation temperature of the wind tunnel supply air. Considerations of the bench tests accomplished and the over-all performance of the model led to the conclusion that the measurements of the turbulent heat transfer rates were within 5 percent of the true values and that the laminar rates were within 15 percent.

The theoretical analysis is based on the mixing length concept and von Karman's evaluation of the mixing length is utilized. An empirical expression is used for the temperature-velocity relation through the boundary layer in an attempt to account for turbulent Prandtl Numbers different from unity. Relations are derived for the local and mean skin friction coefficients, as well as a modified Reynolds' Analogy. The major difference between this analysis and those of other investigators is the boundary condition applied at the edge of the laminar sublayer. The present analysis accounts for the variation in sublayer thickness with the heat transfer rate in accordance with available experimental data.

The results of the theoretical analysis indicate a

significantly different variation of the skin friction with the heat transfer rate when compared with other existing theories. Only a limited amount of experimental data is available and thus a complete evaluation of the analysis is not possible, indicating a need for additional experimental work. Microfilm \$2.00; Xerox \$6.40. 135 pages.

ENGINEERING, CHEMICAL

DIFFUSIONAL TRANSFER FOR DISTRIBUTED PARTICLE SIZES AND EXTENSION OF TWO-PHASE LEACHING EQUATIONS

(L. C. Card No. Mic 59-2377)

Maurice A. Bergougnou, Ph.D.
University of Minnesota, 1958

Equations are developed for diffusional operations from particles, which for the first time, take into account spreads in the sizes of the particles, their porosities and diffusional properties. Each of these properties can be determined directly on individual or on small sets of particles and the values used in the equations to predict performance.

In many cases it will be more advantageous to determine the required empirical parameters from test data on the column or the batch operation. This can readily be done by a curve-fitting procedure and the values then used in the theory for calculation purposes. In the case of column operations, complex effects such as hybridation are taken into account by this procedure. Transfer functions important for control purposes are also obtained.

The leaching of porous spheres impregnated with a solid solute is a moving boundary diffusional transfer problem. Equations are given for the case of spheres of equal sizes in a limited volume of solvent.

Microfilm \$2.00; Xerox \$4.80. 94 pages.

NON-ISOTHERMAL FLOW OF NON-NEWTONIAN FLUIDS

(L. C. Card No. Mic 59-1751)

Samuel Edward Craig, Jr., Ph.D.
University of Utah, 1959

Chairman: Dr. E. B. Christiansen

A fundamental theoretical study of heating non-Newtonian fluids in laminar flow where natural convection is unimportant was undertaken in response to the increasing interest in heat transfer to these fluids.

For this study, the relationship between shear stress, shear rate, and temperature was approximated by the modified Ostwald equation

$$\tau = K(e^{\Delta H^*/RT} \dot{\gamma})^n$$

This equation was then used in a force balance to evaluate

the local velocity which in turn was used in the Fourier equation for conduction to a moving substance. Standard second order numerical approximations were used to convert the resulting partial differential equation into a set of linear, simultaneous algebraic equations which were solved on a Datatron 205 digital computer. The numerical solutions thus obtained are presented as plots of Nusselt number vs. Graetz number, with n and $\frac{\Delta H^*}{RT_w} \frac{T_w - T_i}{T_i}$ as parameters. These curves agree with the known analytic solutions for "isothermal" heat transfer cases. The "isothermal" Nusselt numbers for non-Newtonian fluids are, as Pigford predicted, approximately $\left(\frac{3n+1}{4n}\right)^{1/3}$ times as large as the corresponding Nusselt numbers for Newtonian fluids. However, for the case of heating real fluids, empirical Sieder-Tate type terms commonly used do not adequately account for the variation of fluidity with temperature. Also, the effect of the non-Newtonian parameter, n , upon the Nusselt numbers decreases with increasing $\frac{\Delta H^*}{RT_w} \frac{T_w - T_i}{T_i}$ so that for most systems the effect of the variation of fluidity with temperature partially overshadows the non-Newtonian effect.

Large scale heat transfer equipment was designed and constructed in order to obtain experimental verification of the theoretical results. Tests were made on two non-Newtonian fluids, 3% Carboxymethylcellulose and 0.75% Carbopol. These fluids were heated in laminar flow at constant wall temperature in one-inch, one and one half inch and two-inch pipes having L/D ratios varying from 5.5 to 215.5. The heat transfer data obtained had a mean deviation from the theoretical curves of $\pm 7\%$ except at low Graetz numbers where convection is important. Therefore, the theoretical curves may be used to predict heat transfer coefficients for laminar flow heating of both Newtonian and non-Newtonian fluids in laminar flow when natural convection is negligible.

Microfilm \$2.40; Xerox \$8.40. 184 pages.

A RADIOTRACER DETERMINATION OF ENTRAINMENT IN A BUBBLE-CAP COLUMN

(L. C. Card No. Mic 59-2414)

Vernon Paul Dorweiler, Ph.D.
Iowa State College, 1959

Supervisor: George Burnet, Jr.

A tracer technique was developed for the determination of entrainment in a bubble-cap column, using the I-131 isotope as the tracer. Quantitative relations were developed by treating the tracer directly in material balances. Entrainment rate was calculated from count rate data and simple geometric considerations.

The experimental system was an air-water, non-overflow simulation of a distillation system, in an eight-inch diameter, four plate test column. Activity was introduced on a tray in the sealed column through a hypodermic injection-dispersion system. Entrainment was determined by the transfer of activity from this tray to the next higher tray. The amount of activity transferred

was detected by monitoring the upper tray with a scintillation counter. A device was developed to permit monitoring the two trays with the one unit, accurately reproducing monitoring geometry at the two locations.

The entrainment rate expression was found to be independent of the absolute amount of activity used in preparing samples for the experimental runs. Quantitative handling procedures were found adequate to transfer the differing amounts of activity required by decay corrections. Activity contamination of the test column interior was satisfactorily controlled for a series of experimental runs by vigorous flushing of the column. A quasi-background count was established in the column which was somewhat higher than normal background count but which exhibited a rigid stability. Ninety six experimental conditions were studied with only moderate activity accumulation problems involved. The I-131 isotope proved to be a satisfactory tracer for detection through the column wall and for simple disposal procedures.

A 400-fold change of entrainment rate was determined for forty eight different operating combinations of four variables: vapor velocity, submergence level, slot area and tray spacing. This range was extended further in demonstrating the determination accuracy at very low entrainment rates. Duplication of the operating combinations established that the entrainment data were reproducible with a high degree of precision.

The tracer technique developed is suggested as a general method for measuring transfer between two regions, with difficulty of application as an inverse function of proximity of the two regions. Recommendations for extension of the experimental system and technique are presented.

Entrainment data collected for the forty eight operating conditions were analyzed statistically to evaluate the effect of the four variables, and the interrelationship between the variables. For the range of the variables covered, entrainment rate was found to be nearly a multiplicative function of the variable effects alone. The mechanism of entrainment was described as primarily a projection of drops from the vapor-liquid interface to the next tray. A comparison of the entrainment data developed in this work with the literature data is presented.

Microfilm \$2.00; Xerox \$7.20. 151 pages.

FREQUENCY RESPONSE OF SHELL AND TUBE HEAT EXCHANGERS

(L. C. Card No. Mic 59-2434)

Lewis Iscol, Ph.D.

The University of Wisconsin, 1959

Supervisor: Professor Roger J. Altpeter

In recent years increased emphasis has been placed on the quantitative design of process control systems. An adequate description of the dynamic behavior of the process itself is needed for this work. However the extremely complicated nature of many processes discourages attempts at mathematical description. To a large extent this has been true even in the relatively simple case of the shell and tube heat exchanger.

In the present work explicit transfer functions are derived for many types of commercially interesting shell and tube exchangers. Two types of disturbance may enter the heat exchange system. The temperature of one or more input streams may vary, or the flow rates may change. Only temperature disturbances are considered. The restrictions on the transfer functions derived are no more stringent than those on the well known expression for the logarithmic mean temperature difference. Heat transfer through tube and shell walls is described by the diffusion equation rather than by a lumped approximation. The transfer functions presented make possible the prediction of dynamic behavior from design data.

The complexity of the transfer functions presented makes their evaluation by hand methods essentially impossible. Digital computer programs have been written to perform the necessary arithmetic operations.

In order to be sure that the theory developed actually describes real heat exchangers, a 20 foot long exchanger has been built and its frequency response characteristics obtained experimentally. Agreement with theory is excellent.

Microfilm \$2.00; Xerox \$4.40. 81 pages.

THE STUDY OF RATE FACTORS IN LIQUID PHASE HYDROGENATION

(L. C. Card No. Mic 59-2290)

Herbert Gordon Krane, Ph.D.

The Ohio State University, 1953

The batch liquid phase hydrogenation of ethyl oleate to ethyl stearate with a nickel on keiselguhr catalyst was investigated over a range of temperatures from 121 to 200°C., of pressures from 1.5 to 6.2 atmospheres, of catalyst concentrations from 0.095 to 0.159 pounds of nickel per cubic foot of liquid reactant (from 0.199 to 0.346 per cent by weight of nickel), and of agitator speeds from 800 to 2400 r.p.m. The reaction times for 93 per cent completion ranged from 45 to 300 minutes.

The reactions were carried out in a stainless steel autoclave, 6 1/16 inches in diameter and 8 1/2 inches in depth. The autoclave was equipped with a gas dispersing turbine type agitator and had facilities for loading, draining, introducing of gas, venting bleed gas with reflux of any liquid charge carried over in the bleed, and sampling of the contents. The reactions were carried out with a constant volume of liquid reactant (2820 cc. of ester charge at the temperature of the reaction), which gave a liquid depth of 6 inches in the autoclave under quiescent conditions. A Double Duraseal rotary mechanical seal, counter-pressured by oil, served as the agitator shaft stuffing box.

The autoclave was jacketed, and the desired temperature level in the autoclave was maintained by refluxing a boiling liquid in the jacket by electrical heat. The liquid generally used was ethylene glycol, and the boiling temperature was set by adjusting the pressure on the jacket.

The equipment was constructed so that the course of reaction could be followed by the hydrogen consumption. Hydrogen was fed to the system from an insulated cylinder; pressure and temperature were closely determined. This reservoir for hydrogen was calibrated so that the hydrogen

fed to the system could be determined by the pressure changes (and temperature changes, if any). Before introduction to the autoclave, the hydrogen was purified by passing it through a Baker Deoxo unit and a drying tower. The amount of gas vented from the system was determined by a wet gas meter. The pressure on the system was set by a regulator preceding the autoclave, and a small, constant bleed was set by a needle valve following the autoclave. Hence the autoclave acquired hydrogen as the reaction demanded at the set pressure level. The rate of hydrogen adsorption was directly measured by a rotameter following the pressure regulator. Thus, both the total hydrogen consumption and the rate of hydrogen consumption could be directly determined. The system was essentially leak proof, and calculation of the course of the reaction by comparing hydrogen consumption with analysis of samples of the reactants at periodic intervals gave close agreement.

The hydrogenations were carried out at constant temperature and pressure. No fluctuation of the pressure over the course of the reaction was apparent and the temperature variation was within 4°C.

The catalyst was prepared by modifying Harshaw Chemical Company's Ni 0104 nickel on kieselguhr pelleted hydrogenation catalyst. The pellets were ground in a medium of melted Crisco vegetable oil shortening, and the resultant slurry was hydrogenated as far as possible in the autoclave. The catalyst-hydrogenated vegetable oil mixture was allowed to cool while being agitated, and after the mix hardened, it was broken up into small particles, thoroughly mixed, and stored under nitrogen until used. The protective coating was quite hard at room temperature and allowed handling of the catalyst in air for short periods without deactivation. The modified catalyst analyzed 28.69 per cent by weight nickel.

The charge stock contained 8.1 per cent saturated ester based on ethyl stearate, and 4.5 per cent multiple unsaturated esters based on the same carbon skeleton as ethyl oleate. The data indicated that the multiple unsaturated constituents were selectively hydrogenated in such a way that after about 30 per cent of the possible hydrogenation had taken place, the remainder of the hydrogenation reaction represented the hydrogenation of ethyl oleate.

The charge stock contained catalyst "poisons" which had the effect of deactivating 0.083 pounds of nickel per cubic foot of liquid reactant over the range of catalyst concentrations studied. Some hydrogenation would take place at catalyst concentrations below 0.083 pounds of nickel per cubic foot, but the rate was extremely slow.

It was found that the experimental results could be correlated by assuming that the rate of reaction was controlled by a number of physical and chemical steps, including (1) solution of hydrogen into the liquid phase, (2) mass transfer of dissolved hydrogen from the bulk liquid phase into the pore structure of the catalyst and to the catalyst surface, (3) chemisorption of hydrogen on the catalyst surface, (4) mass transfer of ethyl oleate from the bulk liquid phase into the pore structure of the catalyst and to the catalyst surface, and (5) surface reaction between chemisorbed hydrogen and ethyl oleate on the catalyst surface.

The rate of chemisorption of hydrogen could be expressed by a pseudo first order rate equation. This rate is proportional to the difference between the concentration of hydrogen in the liquid at the catalyst interface and the

concentration of hydrogen which would be present there if chemisorption equilibrium existed.

The rate of surface reaction between chemisorbed hydrogen and ethyl oleate could be expressed as a pseudo second order reaction. This rate of reaction is proportional to the concentration of ethyl oleate at the catalyst interface multiplied by the concentration of hydrogen which would be present there if chemisorption equilibrium existed.

The mass transfer steps could most conveniently be expressed as occurring at rates equal to the appropriate concentration gradient driving forces divided by the appropriate resistance to mass transfer. The mass transfer resistance was defined as the reciprocal of the conventional mass transfer coefficients.

The rate of hydrogenation could be satisfactorily expressed as

$$r = \frac{P}{2R_t R_s} \left[\frac{1}{kP} + R_s + \frac{R_t C}{P} - \sqrt{\left(\frac{1}{kP} + R_s + \frac{R_t C}{P} \right)^2 - \frac{4R_t R_s C}{P}} \right]$$

where

r = the rate of reaction in pound moles of hydrogen adsorbed, or pound moles of ethyl oleate reacted, or pound moles of ethyl stearate formed per minute per cubic foot of liquid reactants

P = the pressure of hydrogen, atmospheres

C = the concentration of ethyl oleate, pound moles per cubic foot

k = the pseudo second order reaction velocity constant for the surface reaction, 1/min.-atm., where the surface activity of hydrogen is expressed in terms of the pressure of hydrogen equivalent to the chemisorbed hydrogen concentration, and the surface activity of the ethyl oleate is expressed as the concentration of ethyl oleate at the catalyst interface

R_s = the resistance to mass transfer of the ethyl oleate, minutes

R_t = the total resistance to hydrogen transfer, ft³-min.-atm./lb. mole

$R_t = R_1 + R_2 + 1/k_a$, where R_1 is the resistance to solution of hydrogen, ft³-min.-atm./lb. mole, R_2 is the resistance to mass transfer of the hydrogen to the surface of the catalyst from the bulk liquid phase, ft³-min.-atm./lb. mole, and k_a is the pseudo first order chemisorption rate constant for hydrogen, lb. moles/ft³-min.-atm., where the hydrogen concentrations representing driving forces for chemisorption are expressed in pressure equivalents.

Over the range of conditions studied:

$$k = \frac{(W_n - 0.0832)}{0.0438} (6.1 \times 10^5 e^{-7100/T})$$

$$1/k_a = \frac{(0.0438)}{(W_n - 0.0832)} (3.13 \times 10^{-9} e^{10,450/T})$$

where W_n is the catalyst concentration in pounds of nickel per cubic foot of reactant and T is degrees Kelvin.

At an agitator speed of 1200 r.p.m.:

$$R_s = \frac{0.127}{W_n} (2.24 e^{852/T})$$

$$R_2 = \frac{0.127}{W_n} (96.0 e^{800/T})$$

R_1 was found to be negligible.

A theoretical correlation of the diffusional resistances with agitator speed was not attempted because not enough data on agitation was available for a fundamental treatment of the problem. However, the value of R_3 at 2400 r.p.m. was about 25 per cent of its value at 1200 r.p.m.; the value of R_2 at 2400 r.p.m. was 72 per cent of its value at 1200 r.p.m. Both R_3 and R_2 increased more rapidly as the agitation speed dropped below 1200 r.p.m., but part of this seemed to be caused by settling out of catalyst from the reaction zone.

Both the experimental results and the rate equation developed to correlate these results indicate that as the operating variables change, the relative importance of the different rate controlling steps in their effect on the course of the reaction changes. For example, at 121° C. and 1.6 atmospheres the surface reaction velocity potential is the most important factor determining the rate of the reaction, whereas at 200° C. and 1.6 atmospheres, the mass transfer potentials of hydrogen and ethyl oleate are more important than the surface reaction in determining the rate of reaction. Above 160° C. the chemisorption of hydrogen is no longer an appreciable factor in determining the reaction rate. Increasing the hydrogen pressure increases the relative importance of the mass-transfer of ethyl oleate as a rate determining factor. However, there is no sharp transition in the relative importance of the various rate controlling factors, and all of them must be taken into account to satisfactorily describe the course of the reaction. Microfilm \$4.00; Xerox \$13.60. 311 pages.

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SELF DIFFUSION IN ARGON TO 300 ATMOSPHERES

(L. C. Card No. Mic 59-1632)

Thomas Roche Mifflin, Ph.D.
Purdue University, 1959

Major Professor: C. O. Bennett

The purpose of this investigation was to study the self diffusion of argon at 49.4°C and at pressures up to 300 atmospheres, and to develop a new method for measuring the coefficient of diffusion.

The diffusion coefficient of radioactive A^{37} through ordinary argon was measured in two different diffusion cells. One of the cells was of a somewhat standard design, employing a plug of porous bronze through which the diffusion process occurred. The cell was arranged so that the radioactive gas diffused from one ionization chamber, through the porous plug and into a second ionization chamber. The diffusion coefficient was determined from the rates of change with time of the A^{37} concentration in the ionization chambers. The concentrations of the tracer were determined from the ionization produced by the tracer's radiation. The dimensional characteristics of the porous plug were calibrated through comparison of diffusion data from the cell with the known coefficient of diffusion at atmospheric pressure.

The second diffusion cell was of a novel design employ-

ing an open, annular path between two ionization chambers. The important feature of this cell was a series of four electrodes along the annular diffusion path. These electrodes in conjunction with the body of the cell formed, in effect, four small ionization chambers along the path, thus allowing the measurement of concentrations along the path of diffusion. The determination of the diffusion coefficients with this cell did not require the investigator to make certain assumptions connected with the porous plug cell calculations. The diffusion coefficient with the annular cell was determined from the measured concentration gradient along the path of diffusion and the measured flow of A^{37} leaving the end ionization chambers.

The ionization currents were measured with a Lindemann electrometer circuit and were in the range of 10^{-11} to 10^{-13} amperes. The pressure range of the study was from 68.0 to 291.0 atmospheres at a temperature of 49.4°C.

The experimental results from the porous plug cell showed the following variation with density of the self diffusion coefficient-gas density product:

$$D_{11}\rho = 28.3 - 0.36\rho$$

where D_{11} = self diffusion coefficient of argon, cm^2/hr

ρ = molal density, moles/liter

The maximum deviation of the experimental results from this line was approximately 20 per cent.

The variation of the $(D_{11}\rho)$ product with density in the above equation was approximately half-way between the ideal gas variation of $(D_{11}\rho)$ and the variation of $(D_{11}\rho)$ as predicted by the Enskog dense gas theory based on rigid spherical molecules. The measured variation was very close to the variation predicted by the Enskog dense gas theory as modified for real gases.

The results from the annular path cell showed the need for a modification of this cell to restrict convection from the open annular path. The coefficients determined with this cell spread very poorly and were not used in the determination of the above equation.

Microfilm \$2.10; Xerox \$7.40. 157 pages.

BARRIER ELECTROPHORESIS

(L. C. Card No. Mic 59-2697)

Edward John Mizma, Ph.D.
Cornell University, 1959

This work proposes a new method of continuous electrophoresis. Two concurrent flow streams separated by a porous wall are subjected to an electric field perpendicular to the wall. One of the streams contains a mobile component which will electrophoretically migrate toward and through the porous partition. The flowing stream on the other side of the partition then acts as a receiver stream to collect the migrating species. In this manner, a continuous separation occurs which may be called barrier electrophoresis; the porous wall acts as a barrier to convective mixing of the two parallel streams.

An apparatus five feet long was built from methyl methacrylate polymer in which the flow channels for the feed and receiver streams were 1.5 inches wide by 0.1 inches deep. The porous barrier between the transfer

streams was of a tetrafluoroethylene polymer ("Teflon"). The electrodes were located in compartments separated from the transfer streams by porous polymethyl methacrylate ("Flexolith"). The stainless steel electrodes were 1.0 inch wide.

Transfer of dyes and hemoglobin was accomplished across the barrier. Flow rates were 10 to 30 ml/min and potential gradients were 2.3 to 6.5 volts/cm in the apparatus. Laminar flow was used because calculations showed the separation to be more efficient for laminar than for turbulent flow.

The degree of separation could be predicted from a knowledge of channel length, channel depth perpendicular to the porous wall, flow velocity, and electrophoretic velocity. The ratio of actual to predicted separation was about 95% for basic fuchsin, a positively charged dye; it was about 70% for brom phenol blue, a negative dye. The lower value from brom phenol blue was explained in terms of a surface conductance phenomenon in which the transfer of a negative species is hindered. Only one run was made with hemoglobin, a negative protein at pH 9.0. The transfer was only about 25% of that expected; no satisfactory explanation for the low value could be given.

Included in this work are streaming potential measurements for a variety of porous materials which might be used as the barrier in a continuous electrophoresis apparatus. Microfilm \$2.00; Xerox \$6.20. 129 pages.

ENTHALPY OF ALCOHOL-HYDROCARBON SYSTEMS

(L. C. Card No. Mic 59-1649)

Truman Sophus Storvick, Ph.D.
Purdue University, 1959

Major Professor: Dr. J. M. Smith

A flow calorimeter was used to measure the enthalpies of pure benzene, n-pentane and ethanol and binary mixtures containing 75, 50, and 25 mole per cent ethanol in benzene and n-pentane. These data covered a temperature range of 250°F to 500°F at pressures from 50 to 1700 psia. The vapor, liquid and two phase regions were studied. Data were obtained in the critical region for the pure components and all of the mixtures. Heat of mixing data appearing in the literature were used to refer all mixture data to a pure component basis.

Pressure versus enthalpy diagrams were prepared for all mixtures and pure components investigated. Tabulated values of the enthalpies were presented for the saturated liquid and vapor as well as the liquid and vapor regions. All enthalpies were based on a reference state of the pure liquid at 77°F and its vapor pressure.

The enthalpy data in the vapor region were compared with values predicted with generalized correlations which express the effect of pressure on the enthalpy. These correlations are based on the theorem of corresponding states. The predicted values compared favorably with the experimental values for the hydrocarbons but deviated considerably from the experimental ethanol data.

The unusually high enthalpy deviations of strongly polar gases, such as ethanol, were explained by assuming association occurred in the gas phase. This association effect

was superimposed on the contribution of molecular geometry. The geometric contribution was calculated for an equistructural hydrocarbon, or homomorph, at the same temperature and pressure as the polar gas. The association effect was treated as a chemical reaction in which polymers containing any number of monomer units could be formed. The sum of the heats of formation of each of the polymer units in a given quantity of vapor gave the total effect of association. The expressions obtained were

$$\Delta H_t = \Delta H_s + \Delta H_g + \Delta H_{\text{assoc}}$$

$$\Delta H_{\text{assoc}} = \sum_{n=2}^{\infty} -x_1^n p^{n-1} \Delta H_{fn} \exp \left[\frac{\Delta S_{fn}}{R} - \frac{\Delta H_{fn}}{RT} \right]$$

where

ΔH_t = The difference between the enthalpy of an associating gas at pressure P and the enthalpy of the gas in the ideal gas state.

$\Delta H_s + \Delta H_g$ = The geometric contribution to the difference between the enthalpy of an associating gas at pressure P and the ideal gas state. ΔH_s is the contribution for a compound which has spherical molecules and centrally located intermolecular force centers and ΔH_g the additional contribution for nonspherical molecules with noncentral force centers. This sum is obtained directly from a generalized correlation applied to the homomorph of the associating compound.

ΔH_{assoc} = The enthalpy difference due to association.

x_1 = The mole fraction of the associating compound remaining in monomeric form.

P = Total pressure

ΔH_{fn} = The heat of formation of the nth polymer.

ΔS_{fn} = The entropy of formation of the nth polymer.

T = Absolute temperature.

The generalized correlation of Pitzer and co-workers was used to obtain the enthalpies of the homomorphs. The heat and entropy of formation for the dimer obtained by fitting the equation to the ethanol data compared favorably with the values given in the literature. This equation was used to predict the enthalpy deviations for methanol and n-propanol. The results were considerably better than obtained from the other generalized correlations.

The generalized correlations using the pseudocritical and true critical points were used to predict the mixture enthalpies. The results were found to be unreliable when compared to the experimental values. Isolated cases were reliably predicted by this technique.

An equation was developed that related the mixture enthalpies to the pure component values. The effect of association was isolated from the molecular geometry by the equation given above for a pure polar compound. This association effect can be added to the molecular geometry factors for a binary mixture of the associating molecule homomorph and the nonassociating compound. This can be represented by

$$\Delta H = x_1^2 \Delta H_1 + 2 x_1 x_2 \Delta H_{12} + x_2^2 \Delta H_2 + \Delta H_{\text{assoc}}$$

where

- ΔH = The difference between the actual and ideal gas enthalpies for the mixture.
- ΔH_1 = The difference between the actual and ideal gas enthalpies for the associating compound's homomorph.
- ΔH_2 = The difference between the actual and ideal gas enthalpies for the nonassociating component in the mixture.
- ΔH_{12} = The interaction parameter taken as $\sqrt{\Delta H_1 \Delta H_2}$.
- x = The mole fraction of each component.
- ΔH_{assoc} = The enthalpy deviation due to association obtained from the expression for the pure components given previously.

This equation predicted the enthalpy deviations from the ideal gas state for the mixture with good precision. The mole fraction of the monomer and the homomorph, x_1 , was taken as equal to the mole fraction of the associating component in the binary polar-nonpolar mixture. No mixture properties are required to apply this equation to polar-nonpolar mixtures. This fact and its accuracy constitute its advantage over other predicting schemes.

Microfilm \$2.90; Xerox \$10.00. 222 pages.

AN INVESTIGATION OF STRESSES IN GLASS BOTTLES UNDER INTERNAL HYDROSTATIC PRESSURE

(L. C. Card No. Mic 59-2326)

Jo Morgan Teague, Jr., Ph.D.
The Ohio State University, 1953

Introduction

In their role as container or package for many and varied products, glass bottles must safely withstand the normal internal pressures which some products develop during processing and in use. While the magnitude of these pressures is not great, it is nevertheless desirable to consider these glass bottles from the viewpoint of withstanding the maximum internal pressures which may reasonably be expected under actual conditions of use. The investigation is concerned primarily with the behavior of glass bottles under internal hydrostatic pressure, including determination of the glass surface stress distributions and the effect of certain elements of bottle design.

Three one-way beer bottle designs which are typical and representative of good commercial bottles were studied, namely the 12 oz. export shape, 12 oz. select shape, and quart select shape. Vertical cut sections of the three bottle designs are shown in Figures 1, 2, and 3.

Four principal methods of experimental stress analysis employed in this study were: (1) photoelastic studies of frozen stress models (Fosterite), (2) brittle model studies of glass bottles (prototypes), (3) electric strain gauge measurements on glass bottles, and (4) Stresscoat studies on glass bottles.

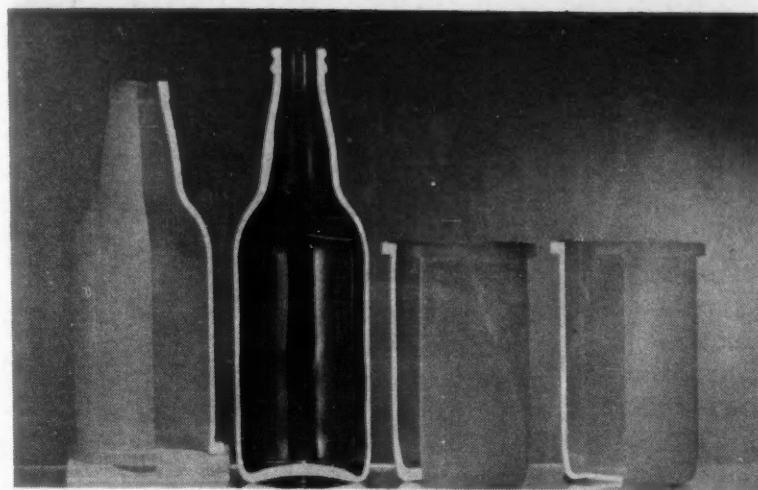


Fig. 1. Vertical Cut Section of 12 oz. Export Shape Beer Bottle with Three Processed Fosterite Models.

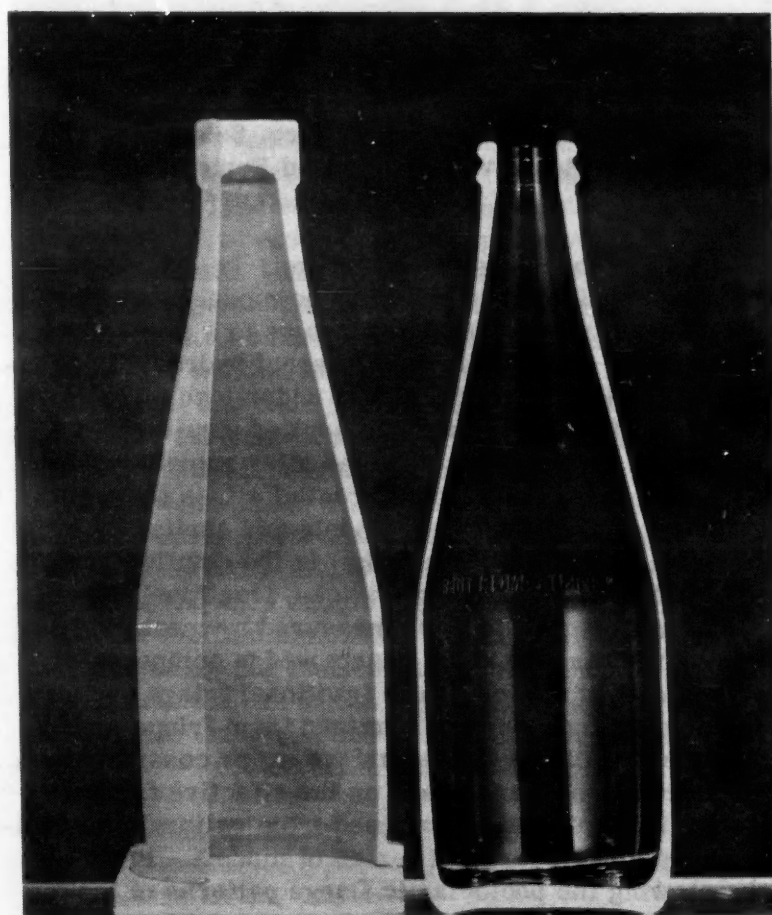


Fig. 2. Vertical Cut Section of 12 oz. Select Shape Beer Bottle with Processed Fosterite Model.

Experimental Studies

Photoelastic Studies of Fosterite Models. — Surface stress distributions were studied by means of the fixation or "stress freezing" method of three-dimensional photoelastic stress analysis which has been described in detail by Leven,^{1,2} Frocht,³ Drucker,⁴ and others. Full scale models of the bottle designs studied were prepared from Fosterite, a widely accepted photoelastic material of the Styrene-Alkyd class of resins developed by the Westinghouse Research Laboratories. Figures 1, 2, and 3 show the completely processed Fosterite models along with the

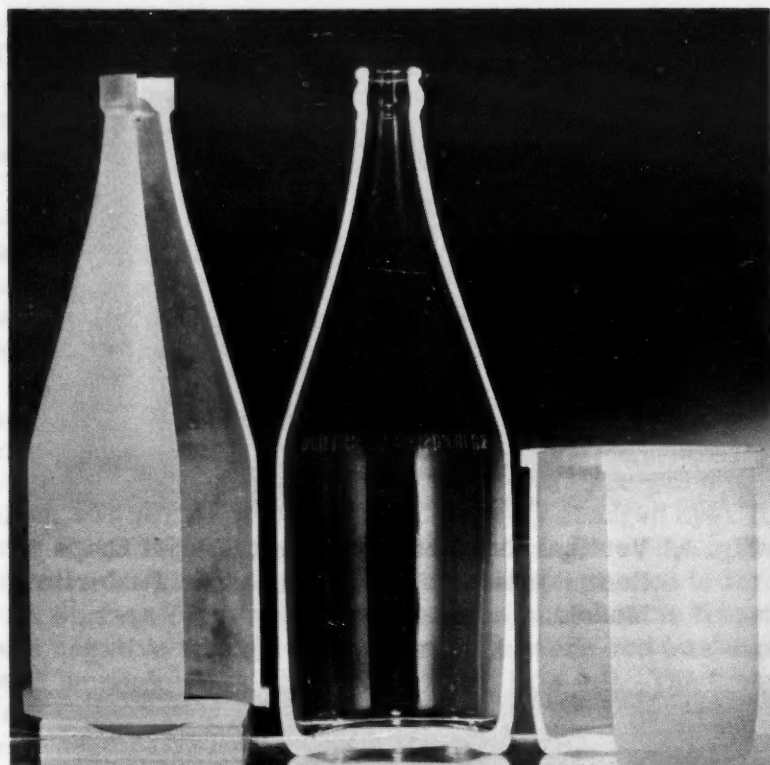


Fig. 3. Vertical Cut Section of 32 oz. Select Shape Beer Bottle with Processed Fosterite Model.

cut sections of the glass bottle designs. In general the processing consists of immersing the model in an inert Silicone liquid, raising the temperature to a prescribed level, applying a predetermined internal hydrostatic pressure, and cooling the model slowly under load to room temperature, thus "freezing" the applied strains in the model, these strains being retained after removal of the load. Longitudinal and circumferential slices were cut from the processed Fosterite models and studied by two-dimensional photoelastic methods. In the detailed photoelastic studies of the Fosterite slices, fractional fringe orders of low magnitude were measured by means of a polarizing microscope and a quartz wedge compensator with a white light source, while fractional fringe orders of higher magnitude were determined from fringe order gradients extrapolated to the surface under consideration. Stress calculations were based on the effective fringe values for the material determined from calibration specimens tested along with each series of models. Photographs showing the photoelastic fringe patterns of the longitudinal slices from each Fosterite model were prepared.

Figures 4, 5, 6, and 7 show the surface stress distribution curves developed from the photoelastic stress measurements. The abscissa of these charts is the stress index (S/P), or stress per unit of applied internal pressure. In the center of each chart a vertical section through the bottle wall is shown schematically to orient the bottle design with the stress curves, and in some cases the bottom section of the bottle is graphically hinged at the outside heel and swung downward to a vertical position so that the stress curves for the bottom could be shown along with the stress curves for the sidewall. The vertical lines marked $D/2t$ on each chart indicate the theoretical average circumferential stress calculated for the cylindrical portion of the sidewall (stress, at unit applied pressure, equals

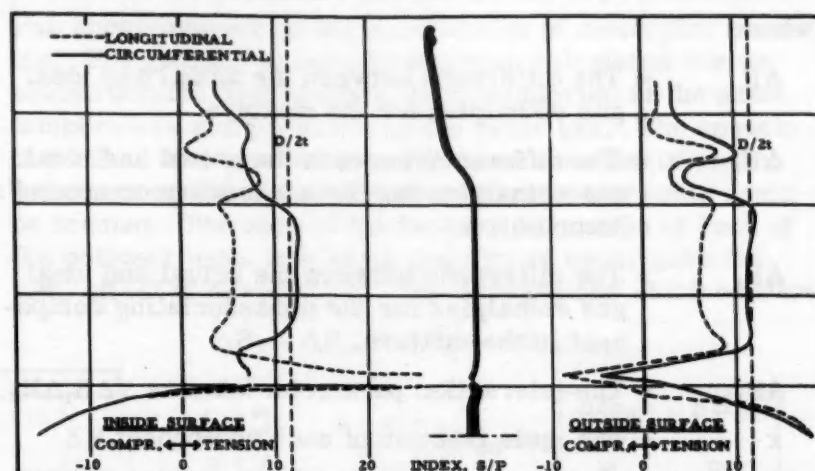


Fig. 4. Measured Surface Stress Distribution Export Shape, 12-oz., One-Way Beer Bottle Under Internal Pressure.

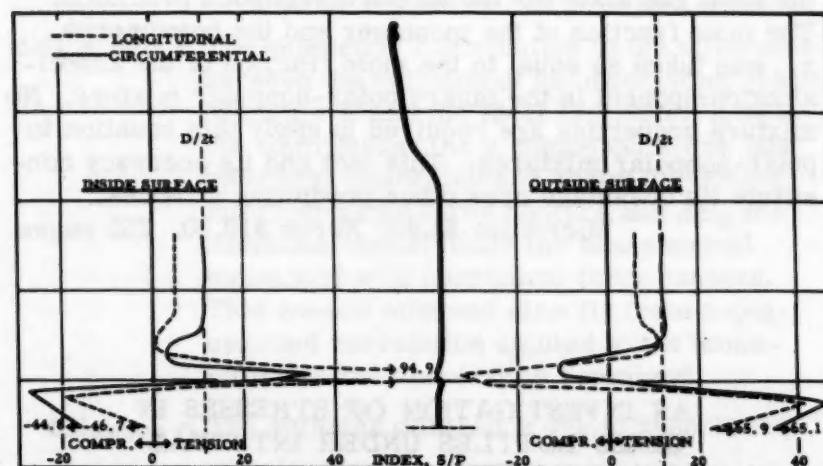


Fig. 5. Measured Surface Stress Distribution - Export Shape, 12-oz., One-Way Beer Bottle With Uniform Bottom & Sidewall Thickness Under Internal Pressure.

the inside diameter divided by two times the thickness of the wall). Agreement with theory was very good.

Bottle Breakage Studies. - Glass bottle breakage studies were conducted in an effort to correlate the information gained from photoelastic studies with the actual performance of the glass prototypes and to observe the characteristics of glass bottles under internal pressure with respect to the location and orientation of breakage origins and fracture patterns and the relation to bottle design, thickness, and condition of the surfaces. The general method involved securing a large number of bottles from a regular commercial production run of the three one-way beer bottles previously described and illustrated, measuring the dimensions of these bottles, conditioning the surfaces of representative lots of each bottle design by various means, pressure testing the prepared samples to destruction, and studying the results to determine the pressure breaking characteristics. Strength characteristics were studied and presented in the form of tabulated internal pressure test results, calculations of average breaking stresses, and frequency distribution curves of bottle-breaking pressures. Glass bottle breakage characteristics were studied and presented in the form of charts showing the location of pressure breakage origins and

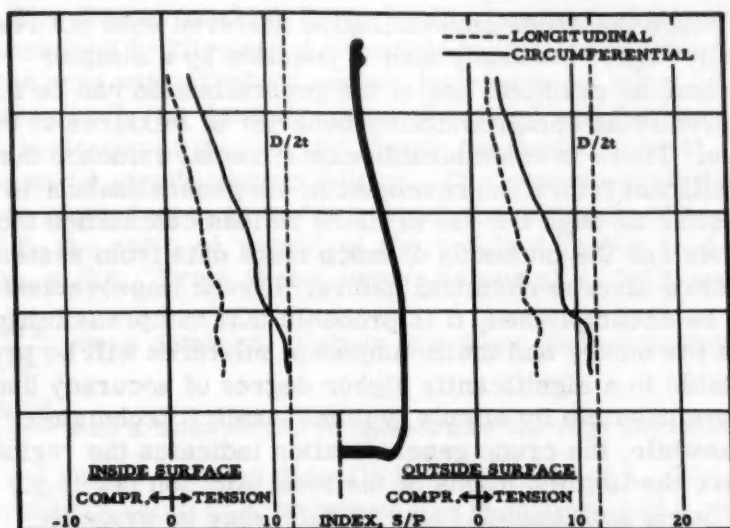


Fig. 6. Measured Surface Stress Distribution Select Shape, 12-oz., One-Way Beer Bottle Under Internal Pressure.

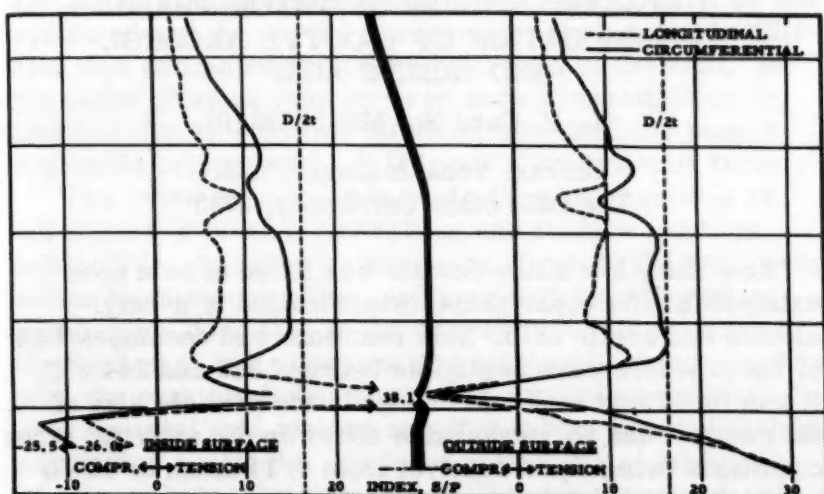


Fig. 7. Measured Surface Stress Distribution Select Shape, Quart, One-Way Beer Bottle Under Internal Pressure.

orientation of fractures plotted on diagrams of the average glass thickness contours for each bottle design studied. Photographs were prepared and presented to illustrate typical fracture patterns of bottles broken by internal pressure.

Electric Strain Gauge Studies on Glass Bottles. — The surface stresses in various locations of the bottle designs under consideration were calculated from electric strain gauge data on representative glass bottles in an effort to correlate glass bottle stresses with those determined from photoelastic studies and with pressure breaking characteristics of the glass bottles. Small A-8 SR-4 electrical resistance type strain gauges were cemented directly to the glass surfaces at the points of interest both on the inside and outside of the bottles. Internal pressure was applied to the bottles and a series of strain measurements were made by means of a Baldwin Southwark SR-4 Strain Indicator. Results of these measurements were studied and presented in the form of tabulations showing comparative stresses determined from electric strain gauges on glass bottles versus photoelastic measurements on Fosterite models, and from calculated bottle breaking stresses

versus strain gauge measurements on glass bottles. Correlations were good.

Stresscoat Studies on Glass Bottles. — The use of brittle coatings (Stresscoat) to study surface strains has been discussed in detail by Hetényi,⁵ Durelli,⁶ and others. In this investigation Stresscoat (a special brittle lacquer) was used on representative glass bottles to determine the qualitative characteristics of the strain produced on the outside surfaces of glass bottles by internal pressure, with no effort being made to secure quantitative measurements of strain. Internal hydrostatic pressure was applied to Stresscoated bottles in increasing amounts until crack patterns were developed in the Stresscoat in the areas of interest. The visibility of the Stresscoat patterns was improved by means of the Electrostatic Powder method known as Statiflux. Photographs were prepared to illustrate the typical Stresscoat patterns developed by the three bottle designs studied. A photograph was also prepared to illustrate the good correlation between the Stresscoat crack patterns and the fracture patterns developed by internal pressure in glass bottles.

General Conclusions

1. The four methods of experimental stress analysis employed in the investigation have valuable and practical applications to the study of the behavior of glass bottles under internal pressure, and comparative results can be well correlated. Each method has its own peculiarities and special applications which may be used advantageously alone or in conjunction with other methods. The method selected for a given investigation depends on the objectives, costs, and time available.

2. The surface stress distribution curves developed in this investigation from photoelastic measurements are valid representations of the state of stress on the surfaces of glass bottles under internal pressure. While these curves apply particularly to the one-way beer bottle designs studied, they should also be applicable to other bottles of similar dimension and design. They should be useful in designing bottles with good pressure strength characteristics and in the explanation and diagnosis of glass bottle fractures due to internal pressure.

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PRESSURE-VOLUME-TEMPERATURE RELATIONSHIPS OF BINARY GASEOUS MIXTURES

(L. C. Card No. Mic 59-1505)

Palmer Wilson Townsend, Ph.D.
Columbia University, 1956

The various methods now used for predicting compressibility data for mixtures have been reviewed. The need for a new volume-explicit method, capable of higher accuracy than that attainable by Kay's pseudocritical method is noted.

The literature on compressibility data for mixtures has been surveyed, and a tabulation made of the range and type of PVT and allied data available for about 85 binary systems. The data available for a few ternary and multi-component systems are also listed.

A slightly modified and simplified Burnett (fixed expansion) compressibility apparatus was built and tested. Since its development in 1936, this simple compressibility apparatus had been ignored in the literature up to the start of this work.

Experimental determination of compressibility isotherms for pure argon and pure nitrogen (at 25° and 50° C, for pressures up to 135 atmospheres) showed the apparatus to give results deviating by a maximum of 0.1% from published values. Other recent investigators have reached similar conclusions.

Experimental compressibility isotherms were determined for four mixtures of argon and nitrogen at 25° and 50°C, for pressures up to 135 atmospheres. For these mixtures under the conditions studied, Amagat's law was found to predict the data with a maximum deviation of 1.4%.

Application of the method of combination of constants to the volume-explicit Beattie equation of state led to the definition of the additivity factor, a new measure of the deviation of real gas mixtures from the ideal solution law (Amagat's law of additive volumes). The additivity factor (A) is related to the compressibility factors (z , z_A , z_B) of the mixture and the two components thereof by the equation:

$$A = 1 + \frac{z - (y_A z_A + y_B z_B)}{y_A y_B (z_A + z_B)}$$

where all of the compressibility factors are evaluated at the pressure and temperature of the mixture. Since the ideal solution law written in terms of compressibility factors takes the form:

$$z = y_A z_A + y_B z_B$$

it can be seen that the additivity factor becomes unity when a mixture follows the ideal solution law.

Compressibility data from the literature for some thirty binary systems were used to calculate more than 8,500 values of the additivity factor over wide ranges of temperature, pressure, and composition. Generalities of behavior were noted in the additivity factor isotherms calculated which permitted fairly good correlation of additivity factors in terms of reduced properties and other parameters. Within limited ranges of applicability, the incomplete and unrefined generalized additivity factor charts developed permit the volume-explicit estimation of compressibility data for binary gaseous mixtures from compressibility data for their components as accurately as by the pseudocritical method (i.e., ± 1 to 5%).

Since the crude generalization achieved does not result in any higher accuracy than is possible by a simpler method, no practical use of the generalization can be made in predicting compressibility behavior of mixtures at this time. There is considerable experimental evidence that significant future improvement in the generalization is possible through the use of more refined calculation techniques and the inclusion of much more data from systems of more diverse chemical nature. If such improvement can be accomplished, it is probable that compressibility data for binary and multicomponent mixtures will be predictable to a significantly higher degree of accuracy than is now possible by simple, volume-explicit techniques. Meanwhile, the crude generalization indicates the regions where the implied forms of the ideal solution law (e.g., the Lewis and Randall fugacity rule) may be properly applied. Microfilm \$5.25; Xerox \$18.40. 409 pages.

CATALYST STUDIES OF VAPOR PHASE ESTERIFICATION OF n-OCTYL ALCOHOL AND ACETIC ACID

(L. C. Card No. Mic 59-2330)

Yerram Venkatesham, Ph.D.
The Ohio State University, 1953

Low iron, low silica bauxite was found to be a good catalyst for the vapor phase esterification of n-octyl alcohol and acetic acid. Side reactions and decomposition of the products were negligible between 218 and 244.5°C. It was found that an 8 fold change in the particle size of the catalyst had no measurable effect on the activity; other conditions being equal catalyst from 6/14 mesh to 40/60 mesh (Tyler) gave the same results. The experiments were carried out at two pressures, 0.974 atm. and 0.470 atm., by means of a feed containing from 50 mole to 80 mole per cent octanol. The feed rates were varied from 8 g./hr. to 40 g./hr. and the catalyst weight from 4 to 10 grams. No effect on conversion was noticed when the mass velocity of the feed was doubled as long as the ratio of feed rate to catalyst mass was constant.

The catalyst was found to be very permeable and had a value of 0.558 for the fraction of internal voids. A volumenometer was used to find the true density of the catalyst. Since it was found that air was adsorbed by the catalyst, helium was used in the volumenometer.

The reactor was made of pyrex glass. Ball and socket joints were used to make all the connections so that the reactor could be used at pressures lower than one atmosphere. The vapors of boiling organic compound having the desired boiling point served to heat the reactor. The temperature of the catalyst was measured by a thermocouple immersed in the catalyst bed.

In the runs made at 0.470 atm., suction of the feed from the pump into the reactor was prevented by introducing a capillary tube of suitable size between the pump and the reactor. The vacuum pump was connected to a coarse and a fine bleed nozzles which were controlled by a "Thermocap Relay" attached to a mercury manometer. This arrangement proved to be very effective in maintaining the pressure in the reactor constant within one m.m. of mercury.

The degree to which the esterification took place was determined by titrating the product containing the unreacted acid with standard sodium hydroxide solution. During each run the conversion of octanol was high at the beginning of the run and slowly decreased until it reached a steady state condition. The experimental data were plotted as x , g. moles octanol converted/g. of feed vs. W/F , the ratio of weight of the catalyst to the feed rate, g./hr. From these curves values of x , W/F and

$\frac{\Delta W/F}{\Delta x}$ were obtained. Values of x were plotted against

$\frac{\Delta W/F}{\Delta x}$ and a smooth curve was drawn through the points to get values of rates directly for any value of x . For a particular value of x , values of p_A , p_B and p_R and r were obtained and tabulated. It could be shown by qualitative considerations in the light of the data obtained that neither the adsorption of any one of the products nor the adsorption of acid was the rate controlling step in the vapor phase esterification. The effect of diffusion from the bulk of the gas phase to the gross surface of the catalyst particle was evaluated and the partial pressure gradient owing to diffusion was estimated to be 2 to 3 per cent of the total. In the range of mass velocity used in this investigation it appears that longitudinal diffusion may not have been a negligible factor, although it is not a predominant factor.

Two other possible rate controlling mechanisms are adsorption of octanol controlling and surface reaction controlling. In order to determine if one of the two mechanisms is rate controlling, evaluation of the adsorption equilibrium constants in the appropriate rate equation by the method of least squares was employed. In conjunction with the equation for adsorption of octanol controlling, the experimental data yielded negative values for equilibrium adsorption constants. Thus the possibility of adsorption of octanol being the rate controlling step was ruled out. The rate equation for surface reaction controlling,¹

$$r = \frac{ksLK_AK_B(a_A \cdot a_B - \frac{a_R \cdot a_S}{K})}{(1 + a_AK_A + a_BK_B + a_RK_R + a_SK_S)^2}$$

was found to fit the data very well. The term $ksLK_AK_B$ is a constant for a given temperature, and for simplicity will be called Q . The activities were expressed as partial pressures. Values of a_R and a_S , being always equal, were factored out, resulting in a term $a_R(K_R + K_S)$ in the denominator. The sum of constants $K_R + K_S$ will be called K_P . The final form of the equation that fitted the data was

$$r = \frac{Q(p_A \cdot p_B - \frac{p_R \cdot p_S}{K})}{(1 + p_AK_A + p_BK_B + p_RK_P)^2}$$

The values of the constants were as follows:

T°C	Q	K _A	K _B	K _P	K
218	2.06	1.42	11.94	12.38	16.4
244.5	2.34	1.30	8.49	8.95	11.4

By using the above values for the constants in back calculations, values of r corresponding to a given value of

x were obtained. In view of the equation $W/F = \int_0^x \frac{dx}{r}$, the values of W/F for any given x were obtained by the graphical integration of the curve x vs. $\frac{1}{r}$. The calculated values were in close conformity with the experimental curves. Some deviation of the calculated values from the experimental curves was observed in the case of runs made with feed containing 50 mole per cent octanol. Hence it was concluded that the mechanism of surface reaction controlling was followed more closely when the feed contained an excess of octanol.

Nomenclature

- r = reaction rate, moles/(mass of catalyst) (time)
 - L = the number of molal active centers per unit mass
 - s = the number of equidistant centers surrounding each active center
 - k = reaction velocity constant
 - K_A = adsorption-equilibrium constant of A, octanol
 - K_B = adsorption-equilibrium constant of B, acetic acid
 - K_R = adsorption-equilibrium constant of R, octyl acetate
 - K_S = adsorption-equilibrium constant of S, water
 - a_A, a_B, a_R, a_S = activities of A, B, R, S
 - p_A, p_B, p_R, p_S = partial pressures of A, B, R, S
 - W = mass of catalyst in reactor
 - F = feed rate, mass per unit time
 - x = conversion, moles per unit mass of feed
- Microfilm \$2.30; Xerox \$8.00. 174 pages.

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THE PRESSURE-VOLUME-TEMPERATURE RELATIONS OF METHYLACETYLENE AND THE VOLUMETRIC BEHAVIOR OF ISOPENTANE

(L. C. Card No. Mic 59-2499)

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The University of Texas, 1959

Supervisor: Dr. Kenneth A. Kobe

Introduction The volumetric behavior of hydrocarbons under different conditions of temperature and pressure has been of great theoretical as well as practical interest in the recent years. High pressure techniques have found an extensive and an ever increasing use in various phases of petroleum industry. For the design and control of industrial operations and processes it is imperative to have knowledge of the compressibilities of the individual hydrocarbons. It was therefore the object

of this investigation to determine the pressure-volume-temperature relationships of methylacetylene (propyne) and to investigate the volumetric behavior of isopentane.

Method and Apparatus The apparatus used in this investigation is essentially that described by Beattie (1). Thermostat temperatures were controlled to 0.005°C . by means of a platinum resistance thermometer in conjunction with a photoelectric cell relay and a Mueller bridge. A known amount of the sample was charged to the P-V-T bomb using a weighing bomb and a charging union technique. The sample volume was decreased or increased by injecting or withdrawing a known quantity of mercury from a calibrated mercury injector pump. Pressure measurements were made by a dead-weight gage.

Methylacetylene Methylacetylene used in this work was supplied by Air Reduction Chemical Company and purified by Phillip Petroleum Company, to an estimated purity of 99.9 per cent. Further purification was done by successive freezing, evacuating and remelting of the sample in a glass bulb. The scope of work in this compound was:

1. to determine the pressure-volume-temperature relationships from 50°C to 200°C for pressures ranging from 7 to 310 atmospheres.
2. to report vapor pressures from 50°C . to the critical temperature at every 5° interval.
3. to investigate the critical region.
4. to present saturated vapor and liquid volumes from 50°C . to the critical point at every 5° interval.

Evidences of polymerization of methylacetylene were found at temperatures above 200°C . Its compressibility could not therefore be measured experimentally at higher temperatures. Isotherms at 225° and 250°C were obtained by extrapolation of a cross-plot of the compressibility isobars. The vapor pressure data were used to calculate the constants of the Antoine equation. In its final form the equation

$$\log_{10} P(\text{atm.}) = 4.81207 - \frac{1321.342}{t(^{\circ}\text{C.}) + 301.143}$$

does not deviate from the experimental results by more than 0.055 atmospheres (0.167%) in the range 50° to 120°C .

Most probable values of the critical constants of methylacetylene, obtained from the smoothed data, are:

$$t_c = 129.23 \pm 0.02^{\circ}\text{C.}$$

$$P_c = 55.54 \pm 0.02 \text{ atm.}$$

$$d_c = 0.2449 \pm 0.002 \text{ g./ml.}$$

Isopentane Compressibility isotherms for isopentane were determined at 175° , 188.5° and 200°C . for pressures up to 182 atmospheres. These data are compared with those of Silberberg (3) and Isaac, et al. (2) and the latter are shown to be in error. Investigation of the critical region gave the following values for the critical constants:

$$t_c = 187.8 \pm 0.05^{\circ}\text{C.}$$

$$P_c = 33.66 \pm 0.05 \text{ atm.}$$

$$d_c = 0.236 \pm 0.005 \text{ g./ml.}$$

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Microfilm \$2.25; Xerox \$7.80. 170 pages.

LIQUID-PHASE CATALYTIC HYDROGENATION IN A TRICKLE REACTOR

(L. C. Card No. Mic 59-2280)

Charles Harvey Ware, Jr., Ph.D.
University of Pennsylvania, 1959

Supervisor: Melvin C. Molstad

The liquid-phase catalytic hydrogenation of benzene in a trickle reactor was studied to determine the influence of mass transfer on the observed rate of a reaction taking place at the internal surface of a porous catalyst when the reactants are present in the liquid phase. Temperature, pressure, flow rate, and benzene concentration were varied over the ranges 88°F to 241°F ; 106 psig to 501 psig; 984 cc/hr to 3409 cc/hr; 0.310 to 0.903 mole fraction benzene, respectively. Observed reaction rates varied from 0.000374 to 0.0473 gr-moles cyclohexane formed per hour per gram of catalyst.

A commercial catalyst, nickel-nickel oxide on kieselguhr, was used in a bed of differential thickness. Liquid benzene trickled over the bed in the presence of a continuous hydrogen atmosphere with no bulk flow of hydrogen. Each run was made at constant conditions.

A statistical basis was provided for much of the experimental work. A Taylor expansion of $\ln N$, where N is the observed reaction rate, as a function of the several independent variables and including only first and second order terms was the mathematical model used in the experimental design. The coefficients of this model were determined experimentally. The Taylor expansions of the proposed theoretical models were compared with the empirical model to determine which, if any, was in agreement with it.

At the center of the experimental region - where the best estimates of the regression coefficients are obtained - several effects were observed. The order of the process with respect to hydrogen concentration in the liquid phase was approximately 0.88 and this order increased with increasing temperature. The observed activation energy of the process was 7,700 cal/gr-mole and this value increased with increasing pressure or hydrogen concentration. The rate of the process was independent of flow rate at the center of the experimental region, even though there was appreciable resistance to mass transfer in the liquid layer. The rate was independent of benzene concentration.

The only model which was found to fit the data included resistance to mass transfer in the liquid layer surrounding the pellets plus simultaneous diffusion and chemical

reaction in the catalyst pores. The chemical reaction consisted of a slow adsorption step followed by a surface reaction.

An unusual effect was also observed: at the same conditions of temperature, total reactor pressure and flow rate, two levels of reaction rate were observed with one rate five to ten times greater than the other. The lower rates were those described above. At the high rates it is proposed that the catalyst pores were filled with vapor and the resistance to mass transfer was negligible. A gas-solid reaction took place at the internal surface of the catalyst with an activation energy of 10,100 cal/gr-mole and an observed order with respect to hydrogen concentration in the vapor of 0.11.

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ENGINEERING, CIVIL

BEHAVIOR AND STRENGTH IN SHEAR OF REINFORCED CONCRETE BEAMS AND FRAMES

(L. C. Card No. Mic 59-2016)

Roger Diaz de Cossio, Ph.D.
University of Illinois, 1959

The main object of the studies presented in this thesis was to study the behavior and strength in shear of reinforced concrete members under various loading conditions, with emphasis placed on the cases of uniform and axial loads. The ultimate objective of the experimental program was to obtain information leading to a more rational design of reinforced concrete box culverts under high fills.

The results of 57 tests on simply-supported beams and 24 tests on frame members are described, discussed, and correlated in the thesis. The following major variables were studied during the course of the investigation: type of loading, concrete strength, steel percentage, ratio of axial load to vertical load, ratio of span length to effective depth for members under uniform load, and ratio of shear span to effective depth for members under symmetrical concentrated loads.

The simply-supported beams were tested under one or two concentrated loads, or under uniform load. The frames were tested under uniform load. All members had essentially the same cross-sectional dimensions, 6- by 12-in. Steel ratios ranged from 0.67 to 3.36 percent; concrete compressive strengths from 2500 to 6600 psi; and ratios of simply-supported span length to depth from 3.2 to 15.5. Ten of the simply-supported beams were tested under a constant axial load of 20 kips. The ratios of axial to vertical load in the frame members were 0.17, 0.27 and 0.33.

Two major modes of failures were observed in the tests, flexure and shear. Shear failures can be further subdivided into diagonal tension failures, in which the members fail at the formation of the first major inclined crack, and shear-compression failures, in which the members are able to carry additional load after the formation of the first major inclined crack. The load at which the first major inclined crack formed was denoted as the

cracking load. It was considered that once this load had been reached the members ceased to be structurally useful, and therefore the cracking load was used as a criterion for the ultimate strength in shear of a member.

Of the 81 members discussed in this thesis, 65 failed in shear; the remaining 16 members failed in flexure.

Web reinforcement in the form of bent bars was used in three of the frame members. It was found that the presence of properly located bent bars improved the general behavior of the members after the cracking load was reached. Before the first major inclined crack formed, no differences were found between frames with and without web reinforcement.

By means of least squares analyses and successive plotting, empirical expressions were found for the nominal unit shearing stress at cracking load at the section of zero moment. These expressions represent the test data with a reasonable degree of accuracy.

The expressions already established for the flexural capacity of under-reinforced members under bending alone were extended to take into account the presence of relatively small axial loads. The results of these extrapolations were satisfactorily checked against the results of tests of members that failed in flexure.

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CITY CENTER GOODS MOVEMENT— AN ASPECT OF CONGESTION

(L. C. Card No. Mic 59-2238)

Edgar Miller Horwood, Ph.D.
University of Pennsylvania, 1959

Supervisor: Robert B. Mitchell

The Problem

The central problem at which this research is aimed is that of determining how goods move in the core of a large urban complex, and the relationship between the movement of these goods and the vehicles which carry them. The study further seeks to examine the nature of central congestion and to identify public policy alternatives regarding its control.

Method

The land use of the central region of the city is examined to provide a spatial model for the analysis of both congestion and goods movement. The Central Business District is divided into two primary functional areas termed the core and frame, and a detailed study of goods flow is made within a core delimited for Philadelphia through the examination of establishment shipping records and by interviews. The economic feasibility of goods consolidation for scheduled deliveries is investigated through a study of tariff rates, and various regulatory and design approaches to goods movement in a range of cities are evaluated.

Results

On the basis of Philadelphia experience a very small percentage of the commercial vehicles delivering goods to

the core establishments carry a substantial majority of the total goods delivered. Large combination trucks making consolidated intercity deliveries to the central department stores carry an average load equivalent to as many as forty trucks making deliveries from local vendors to the same establishments. Although over 600 local carriers are franchised by the State Public Utilities Commission to operate in central Philadelphia, two percent of this number could efficiently handle the total volume of goods transported to core establishments through the use of ten or twelve consolidation platforms located just outside of the highly concentrated core area. Central office space generates approximately one vehicular delivery or service call daily per establishment, or daily stops at the rate of about one for each 2500 sq.ft. of rentable office space. Deliveries from local vendors account for a majority of the goods moving into the core area, but there are insufficient economic incentives at current tariff rates to induce consolidation schemes for this goods flow.

Conclusions

In any study of central congestion and traffic flow a differentiation must be made between the Central Business District core and frame based on the widely different functional nature of each. Interference with pedestrian flows by vehicles is of primary concern in the core, but not necessarily in the frame. Until a major redevelopment of our city centers takes place, providing a grade separation of vehicular and pedestrian traffic, consolidation of goods delivery has most to offer toward alleviating the goods movement aspect of core congestion. This consolidation, however, will not take place without government regulation because of the lack of economic incentives to local carriers and the unwillingness of retail outlets to pay for the cost of a breakdown of goods for consolidation purposes. A reduction in the number of local carriers franchised to make deliveries in the core of any city appears to be the most feasible way of effecting consolidation. This could be accomplished by municipal regulation, with enablement from the state as needed, by denying the transfer of core operating rights as local carriers go out of business, until the number of carriers franchised to operate in the core is reduced to a sufficient level to make consolidation economically feasible.

Microfilm \$2.50; Xerox \$8.80. 191 pages.

TIME EFFECTS ON THE CONSOLIDATION PROPERTIES OF CLAYS

(L. C. Card No. Mic 59-1638)

Biskur Kemparamiah Ramiah, Ph.D.
Purdue University, 1959

Major Professor: Dr. G. A. Leonards

This investigation is concerned with the development of a better understanding of the compressibility of fine grained soils. It comprises the study of the effects of load increment duration, load increment ratio and of sampling on both primary consolidation and secondary compression. A preliminary study on the control of secondary compression was also conducted.

Two types of soils, a limestone residual clay and a glacial till, were used. The soils are fine grained and are identified as highly plastic clay (CH) and silty clay of low plasticity (CL), according to the Casagrande classification system.

Test apparatus consisted of 4-7/16 inch brass and plastic rings of the fixed type and 2-1/2 inch diameter brass ring of the floating type. The loading frame was capable of permitting eight tests to be conducted simultaneously and had a capacity of 5,000 kilograms.

Remolded samples prepared at two different water contents were employed in the consolidation tests. Samples extruded from the larger diameter rings after pre-consolidating under a pressure of .4 kg/cm², and rested for twelve weeks, were tested in the floating rings in the conventional manner.

The results obtained showed that duration of load increment has small influence on the e-log p curve and compressibility index, but has considerable influence on the coefficient of consolidation, showing a decrease in C_v-values. During the twelve week rest period, important deviations from a straight line relationship between secondary compression and log time were observed. Load increment ratios would seriously affect the e-log p curve and compressibility index - the coefficient of consolidation decreased considerably with decreased load-increment ratio. Reduction in initial water content would cause reduced compressibility, especially at low pressures. The coefficient of consolidation, and the rate and magnitude of secondary compressions, would also be reduced.

For the soils tested, the data suggest that the rate and magnitude of secondary compression can be controlled by the application of surcharges of appropriate magnitude and duration.

The test results clearly show that apparent preconsolidation pressure is largely a function of load duration, load increment ratio, and secondary compression after a load is applied for a long period of time.

The relative order of magnitude of these effects depend greatly on the consolidation pressure, temperature, and soil type. Microfilm \$2.00; Xerox \$6.60. 136 pages.

ENGINEERING, ELECTRICAL

THE DIELECTRIC TUBE RESONATOR— A SLOW-WAVE, OPEN BOUNDARY, DIELECTRIC RESONATOR FOR THE GENERATION AND MEASUREMENT OF MILLIMETER AND SUBMILLIMETER WAVELENGTH ELECTROMAGNETIC RADIATION

(L. C. Card No. Mic 59-2004)

Richard Charles Becker, Ph.D.
University of Illinois, 1959

The yet unsolved submillimeter wavelength problem, namely, providing a source of high power, coherent, monochromatic signal frequencies in the region 300-3000 kmc/s, together with suitable measuring techniques and devices, is considered. One of the most promising suggestions for obtaining such a source has been the concept

of "megavolt electronics," wherein it has been demonstrated that harmonic frequency generation of a very high order and at high powers, is possible by means of a tightly bunched, relativistic electron beam.

As a solution to problems associated with both aspects of the submillimeter wave problem, the dielectric tube resonator is proposed. Applications of this structure as both a frequency meter and a "harmodotron" beam coupling device for use with megavolt electronics are discussed. Experiments substantiating the improved performance over conventional devices that was predicted for both applications are described.

The dielectric tube resonator consists of a hollow, circularly cylindrical tube of dielectric material suitably terminated at its ends by sufficiently large metal end walls, and constitutes a slow-wave, open-boundary, higher order mode resonator. General solutions to the boundary value problem are derived and are found to necessitate a consideration of the hybrid (HEM) modes in addition to TE and TM mode solutions. Detailed numerical analysis of the modes having circular symmetry (TE and TM modes only) results in the following observations concerning the dielectric tube resonator:

1. The physical size of the resonant structure can be increased by a factor of at least three in all dimensions, and still maintain theoretical values for Q and mode-interference-free bandwidth comparable to those presently achieved using metal cavity resonators.

2. The mode charts are no longer fixed as in the case of metal cavities, but can be made to vary as a function of the dielectric constant of the tube and the thickness of the cylinder wall.

3. Modes of considerably higher order can be used to achieve much higher values for Q over considerable bandwidths because of the mode separation properties of this resonator.

4. The resonant fields possess the "slow-wave" property with respect to the axis of the cylinder, and therefore, proper choice of the dielectric constant and the cross-sectional dimensions of the cylinder permits the phase velocity of the resonator fields to be made equal to the electron beam velocity in harmodotron applications.

The use of the dielectric tube resonator as a beam coupling structure permits the optimum transfer of harmonic energy from the beam to the resonator fields by means of "slow-wave" interaction. In addition, its greater physical size together with improved electrical characteristics appear to make the extension of microwave measuring techniques to wavelengths below one millimeter readily achievable. Microfilm \$4.45; Xerox \$11.00. 348 pages.

LEAST-SQUARES APPROXIMATION FOR BOTH MAGNITUDE AND PHASE BY RATIONAL FUNCTIONS

(L. C. Card No. Mic 59-2020)

King-Sun Fu, Ph.D.
University of Illinois, 1959

A method is presented to approximate both magnitude and phase within a given band. The specified magnitude and phase characteristics, either in the form of a function

or in terms of a graphical plot, are approximated by a rational function in the sense of minimizing the least-squares error. The digital computer can be used to obtain accurate results quickly.

Preassigning the pole locations sometimes enables the network finally realized to possess particular properties such as whether the network will contain only two types of elements (RL, RC) or all three types of passive elements (RLC), or whether the network function will be an all-pole transfer function. Error improvement by proper selection of poles is described. The approximation method is also extended to the time-domain approximation and the simplification of a transfer function by an RC (or RL) function or an all-pole function.

Microfilm \$2.00; Xerox \$4.00. 73 pages.

NEW TECHNIQUES FOR REALIZATION OF TRANSFER FUNCTIONS

(L. C. Card No. Mic 59-2024)

Seifollah Louis Hakimi, Ph.D.
University of Illinois, 1959

DeClaris has shown that the transfer function of a network consisting of resistors, capacitors, and one inductor has no more than one pair of complex conjugate poles. It is shown in this thesis that for every transfer function that is realizable as a grounded two terminal-pair RLC network and that has only one pair of complex conjugate poles, a grounded two terminal-pair network can be found which realizes the given function within a constant multiplier and which contains only one inductor.

It is well known that the transfer function of a grounded two terminal-pair RLC network cannot have any zeros on the positive real axis. A simple synthesis procedure using an ideal transformer is given. By means of this procedure one can realize transfer functions with zero on any part of the complex plane. This procedure is applicable only when the poles of the transfer function are distinct and lie on the negative real axis. In connection with this procedure, a method for increasing the gain constant is also discussed.

A procedure for the synthesis of grounded two terminal-pair RLC networks is given. By means of this procedure one can realize any voltage transfer function which satisfies the necessary conditions for realizability and which has no poles on the imaginary axis.

Microfilm \$2.00; Xerox \$4.20. 79 pages.

A PRACTICAL SYSTEM FOR MEASURING FM NOISE IN KLYSTRONS

(L. C. Card No. Mic 59-2487)

Larry Lee Huggins, Ph.D.
The University of Texas, 1959

Supervisor: Dr. A. W. Straiton

The system for measuring FM noise in klystrons in which the time delay is introduced at microwave frequencies

is practical and relatively straight-forward. Since for most klystrons, the FM noise level in the frequency range of interest of doppler radar systems is relatively high, typically 60 to 70 db below the carrier at 10-kc, a 120 foot run of rectangular waveguide is suitable for the delay line. For systems in which it is desirable to measure FM noise at lower levels, the use of a circular waveguide delay line with its low attenuation characteristic is necessary.

A reasonably accurate correlation between AM and FM noise can be made using the static characteristics of the klystron. The effect of feedback on AM and FM noise output of the klystron is as would be expected for an externally modulated perfect oscillator.

Microfilm \$2.00; Xerox \$3.80. 70 pages.

CROSSED FIELD ELECTRON INTERACTION IN SPACE CHARGE LIMITED BEAMS

(L. C. Card No. Mic 59-926)

Joseph F. Hull, D.E.E.

Polytechnic Institute of Brooklyn, 1958

Adviser: Dr. Ernst Weber

This paper presents a semi-heuristic, semi-theoretical analysis of electron interaction in crossed field electron tubes having space charge limited beams. This analysis is applicable to the magnetron oscillator, the amplatron, and to other high power crossed field oscillators and amplifiers yet undeveloped.

A new unified physical picture has been drawn of the space charge bunch formation, dc anode current determination from the space charge, and phase angle between the bunch and the space harmonic. This physical picture has been translated into approximate mathematical language in the form of six basic interaction equations, with seven operating variables. In any given tube type (i.e., magnetron oscillator, backward wave amplifier, forward wave amplifier, etc.) these equations may, in principle, be solved simultaneously to obtain the relation between any two of the variables. Two important quantities that may be calculated are the real and reactive power delivered by the bunched electrons to the slow wave structure as functions of the dc applied electrical parameters. For a crossed field amplifier the real power is related to gain of the tube, and the reactive power is related to the electronic perturbation of the phase shift.

The six basic interaction equations have been applied to the oscillating magnetron. Expressions have been evolved for rf power output characteristics, pushing curves, electronic efficiency, performance plot characteristics, frequency characteristics of Rieke diagrams, and other relationships which are functions of electron interaction. All these characteristics have been calculated for three basically different types of magnetrons with parametric variation of rf output loading, magnetic field, anode current, and interaction space dimensions. All these calculations are compared with experimentally measured characteristics.

From the comparison between calculated and measured data, it is concluded that a correct physical picture of this type of crossed field interaction has been formulated, and

a fair mathematical representation of this picture has been evolved for the magnetron oscillator. This paper leads the way toward refinement of the mathematical formulation, and toward the application of the theory to other crossed field tubes with space charge limited beams currently in development.

Microfilm \$3.80; Xerox \$12.80. 294 pages.

SURFACE POTENTIAL CHANGES CAUSED BY THE ADSORPTION OF ODOROUS MATERIAL FROM THE ATMOSPHERE

(L. C. Card No. Mic 59-1628)

Julius Otto Kopplin, Ph.D.

Purdue University, 1959

Major Professor: J. R. Eaton

The changes in surface potential of various surfaces caused by the adsorption of different odorous materials were investigated. The purpose of the investigation was to determine the feasibility of detecting and identifying various vapors through the measurement of surface potential changes caused by their adsorption and also for establishing relationships between the physical properties of the adsorbate molecules and surface potential change due to their adsorption.

The Kelvin method of measuring contact potential differences was used. A filtered air stream, the humidity of which was variable and controlled and into which could be injected a measured amount of contaminant vapor, was passed between two parallel electrodes. The upper electrode surface was desensitized with a coating of paraffin wax or other material so that detectable amounts of adsorption and surface potential change took place only on the lower electrode surface. Surface potential changes at the lower surface were measured using the vibrating-capacitance null-balance technique.

Various liquids were used to form the adsorbing surface with extensive use being made of distilled water. The liquids, contained in a shallow dish, formed the lower electrode of the vibrating capacitor. It was found that small amounts of alcohol vapor in an air stream could be detected by noting the change in surface potential of a distilled water surface independent of the water vapor content of the air stream.

Different normal homologous alcohol vapors (of 2, 3, 4, 6 and 8 carbon-chain lengths) were individually injected into an air stream in amounts from 0.08 to 800 parts per million by volume. These vapors were adsorbed from the air stream onto a distilled water surface and the change in surface potential of the water was noted. Alcohol vapor concentrations in the air stream of the same order of magnitude as the minimum concentration which can be detected by the human nose caused measurable changes in surface potential. A linear relationship was established between the logarithm of the vapor concentration in parts per million in the air stream and the change in surface potential in millivolts for each of the different alcohol vapors.

It was further found that, if the logarithm of the alcohol vapor concentration required to produce a specific change

in surface potential were plotted against the logarithm of the number of carbon atoms for the different normal alcohols, a straight line relationship was indicated. This is analogous to the linearity, reported by other investigators, between the olfactory rejection thresholds of the normal alcohols and their respective chain lengths when plotted on logarithmic coordinates.

Experimental evidence also indicated that certain vapors of different chemical classification might be distinguished from each other by finding the maximum temperature of the adsorbing surface at which the particular vapor will adsorb in sufficient amounts to produce measurable surface potential change.

Preliminary experimental investigation was also made of the use of radioactive isotopes for determining the amount of adsorbed material causing a change in surface potential. Microfilm \$2.00; Xerox \$5.00. 99 pages.

POSITIVE FEEDBACK PHASE-SPACE TRAJECTORIES AND APPLICATIONS TO SERVOSYSTEMS

(L. C. Card No. Mic 59-2402)

Zvi H. Meiksin, Ph.D.

University of Pittsburgh, 1959

A new method to shorten the response time of a positioning type servosystem and maintain the stability of the system is to reverse the polarity of the direct feedback during the transient period. This may be visualized most easily by considering a second order system. The system starts to respond with positive feedback. The actuating signal is then equal to the sum of the input signal and the output signal of the system. As the system starts to respond, the actuating signal is increasing rather than decreasing as is the case for conventional negative feedback systems. This larger actuating signal provides proportional increased acceleration of the system. To provide the required stability, the system switches into negative feedback operation at an instant established by a predetermined relationship between the error and the error rate of the system. Once the system operates with direct negative feedback, the actuating signal is given by the difference between the input signal and the output signal of the system, or the error, which reduces to zero when the system reaches the steady state. The negative feedback during the latter part of the transient period provides nonerratic operation near the rest position.

For signals large with respect to the saturation level, the system with positive feedback may be driven into saturation for a large portion of the transient period, before the system switches into negative feedback. This provides an economical design, because the system is then utilized to its maximum capacity. A conventional negative feedback system with the same components would not be driven into saturation for the same input signal. If the switching system is critically damped throughout the transient period, the response time is reduced to the order of 60 per cent of the response time of the corresponding linear negative feedback system. The response is further improved if the system is less than critically damped during the positive feedback mode, and more than

critically damped during the negative feedback mode. The response time may then be reduced to the order of 10 per cent. Higher damping during the negative feedback mode of operation also provides a simple switching condition as described in the following paragraph.

The second order system is analyzed in the phase-plane, which provides a description of the behavior of the system in terms of the error and the error rate of the system. This representation provides a straightforward means to determine the required switching conditions. The phase-plane portrait is composed of curves, termed trajectories. For the more than critically damped negative feedback system the portrait has two eigenvectors which are straight line trajectories. Switching from positive feedback to negative feedback along the proper eigenvector secures fast response with no overshoot. The switching condition is then given by a simple linear relationship between the error and the error rate.

The third order system is analyzed in the phase-space, which describes the system in terms of the error of the system and the first and second derivatives of the error. One switching action takes place when the system reaches a state which corresponds to any point on a surface, which is composed of positive feedback phase-space trajectories, and includes a negative feedback eigenvector. Another switching condition is again given by a relationship between the error and the error rate of the system as determined by one of the three eigenvectors of the negative feedback trajectories. Higher order systems may be analyzed by the same technique.

This principle of operation may be extended to ramp and sectional linear input functions. The switching conditions and the mechanization of the system will however become more complicated.

In general, the more known about the possible input functions and initial conditions, and the more limited these conditions are, the simpler is the control mechanism of the system. The system proves most useful for step and jump (staircase) input functions.

Microfilm \$2.55; Xerox \$8.80. 194 pages.

THE CORRELATION BETWEEN CLASSICAL AND POLE-ZERO SENSITIVITY

(L. C. Card No. Mic 59-2039)

James Joseph Mikulski, Ph.D.

University of Illinois, 1959

The correlation existing between the over-all sensitivity of a network or system function (Mason) and sensitivities of the poles and zeros, or roots, of that function (Truxal) is established. This unifies the studies previously carried out as separate entities. The pole-zero, or root, sensitivities have previously been defined for the cases where the coefficients of the rational network function were dependent linearly upon some parameter. This thesis extends the root sensitivity to the case of a non-linear dependence of the coefficients, and in doing so introduces a concept of a second-order sensitivity that is applicable and useful in the classical sensitivity definition. In this work, the nature of the frequency dependence of the classical sensitivity is utilized to derive the root sensitivities.

A characteristic of previous root sensitivity definitions or investigations has been their failure to characterize the variation of a multiple root under a finite parameter change. The reason for this failure, and a rigorous derivation of the root sensitivity as a differential limit, are given. An extension of the sensitivity concept to multiple roots is made possible through the correlation established. It utilizes all the information about the multiple root sensitivity present in the classical sensitivity function, and allows an approximation to the root variation, due to finite parameter changes to be made. At the same time, the study of the roots of a function which may appear when the parameter varies, but are not present for the nominal parameter value, is made. This case is extremely important for a Brune network where the parameter is the coefficient of coupling of the transformers.

In order to make the theory practically applicable to network or system theory, a study is made of the sensitivities when n parameters are allowed to vary simultaneously. A superposition of sensitivities is shown to be possible and determination of element tolerances through sensitivity considerations is suggested.

The concept of sensitivity is introduced into the time domain. Various methods of treating a time domain sensitivity are presented to meet whatever criterion on the performance in that domain is applied. The study of sensitivity is linked to that of topology, and a method of topological determination of sensitivity functions indicated. Through this connection the possibility of adjusting the network geometry to control sensitivity is visualized.

The theory developed is illustrated and tested by means of a set of examples. These examples are obtained from the field of passive network synthesis. In this way, the same function, a driving point impedance, is realized in a variety of ways and the variation of that function studied as various parameters of the networks are altered. The behavior is predicted by means of sensitivity and checked by a digital computer solution of the network problem. The means by which the sensitivity can be used to choose a network realization are indicated.

Microfilm \$2.00; Xerox \$4.80. 91 pages.

CONTRIBUTIONS TO TRANSISTOR-RC NETWORK SYNTHESIS

(L. C. Card No. Mic 59-2044)

Basil Roland Myers, Ph.D.
University of Illinois, 1959

The only passive circuit elements retained in this study are resistors and capacitors, and the junction transistor is retained as the sole active element. A new, functional, symbolic equivalent circuit of the junction transistor is introduced which leads to ready interpretation between physical circuits and the mathematical functions describing them.

By way of a specific topic, the concept of the ideal negative impedance converter is extended to converters with a general, including complex, conversion ratio. A comprehensive design theory which leads to practical circuits, and a study of the impedance properties of these circuits is given. Certain equivalence relationships be-

tween NIC circuits and two-port networks containing all negative elements are established. These relationships find ready application in active synthesis.

Another specific topic, the realization of RL impedances by active RC means, is considered. The main approach is through the design of two-port RC-to-RL converter sections. Circuits are given for realizing any RL impedance, both positive and negative.

In contribution to the store of existing synthesis techniques, several new methods of transfer function realization are given. The most significant of these is a simple but powerful method for realizing unrestricted complex poles of transmission. The power of the method lies in its simplicity, and in the fact that the synthesis is from one end of the network, so that the synthesizer is able to maintain control over the poles of the driving-point function. The negative elements which arise are all accommodated in a single shunt branch across the output terminals, realizable by a single NIC. A simple extension of this method, utilizing topologically-generated zero-producing sections, enables the simultaneous realization of complex zeros and unrestricted poles, where the zeros may be in the right-half-plane. In addition, two methods for general transfer function synthesis, a method for exact realization of a single pair of poles of transmission which utilizes only one transistor, and a method for synthesizing a complex pole pair when the network terminations are specified, are given.

Finally, three methods of realizing non-positive-real impedances are described.

Microfilm \$2.00; Xerox \$5.60. 114 pages.

ANTENNA APERTURE ILLUMINATION, RESOLUTION, AND IMAGE QUALITY

(L. C. Card No. Mic 59-2045)

John James Myers, Ph.D.
University of Illinois, 1959

An evaluation was made of the effect of aperture illumination on the resolution and image-quality performance of a large-aperture antenna. Of particular interest was the imaging of a continuum of objects, such as in radar mapping, as contrasted to imaging of relatively isolated objects. The evaluation was made by three means:

1) A mathematical evaluation based on various image quality criteria that have been suggested by antenna and optical theory. Each of the criteria was analyzed to determine its essentials and to find the relationships between the various criteria. The results of this analysis led to a catalog of image quality criteria useful in antenna theory.

2) An experimental evaluation that made use of an optical technique for simulating antenna images, and human observers for judging the quality of the images. The technique consisted of off-focus imaging of objects through variable density weighting masks in front of a camera lens. A set of objects consisting of random Roman letters on a background of objects of random form and size was used to form sets of images through various weighting masks corresponding to particular antenna radiation patterns. The images formed were recorded

on photographic film for direct viewing by observers, who judged the quality of them.

3) An experimental evaluation based on assessment of image quality by a mechanical observer, which was designed by programming ILLIAC (the University of Illinois digital computer) as an observer. Images were manufactured by ILLIAC for different aperture illuminations. In attempting to analyze the images by a "deconvolution" scheme, i.e., to find correctly the targets used in forming them, the mechanical observer yielded a measure of the quality of the images. Analyses of groups of images manufactured led to the determination of an optimum illumination as measured by the mechanical observer's effort expended in finding the targets.

By each of these three means, an investigation was made of the class of illuminations given by $(1 + A \cos 2\pi x/L)$, where x is the aperture coordinate, L is the antenna length, and A is an aperture illumination parameter defined over the interval $(-1, 1)$. The optimum of the class was determined by both the mathematical and the experimental means.

The results of the mathematical investigation of this class of illuminations are given in the form of graphs of relative image quality as a function of the aperture illumination parameter. A detailed description of the techniques used in the optical experiment is given together with photographs of typical images, typical objects, and the masks used. Results of the optical image evaluation are given in the form of graphs plotted to show relative image quality as a function of the aperture illumination parameter. In describing the other experimental work, the logical design of the mechanical observer is given in detail, and a block diagram of the program used is included. The results of image analysis by the mechanical observer are also presented in the form of graphs giving relative image quality as a function of aperture illumination factor.

The conclusion drawn from the evaluation was that antenna image quality is not highly sensitive to aperture illumination and that a uniform illumination is close to optimum for the important class of applications investigated. It was also concluded that special efforts to obtain particular illuminations are unwarranted for these applications. Microfilm \$2.25; Xerox \$7.80. 170 pages.

INVESTIGATION OF TRANSMISSION LINES HAVING CONTINUOUSLY VARYING PARAMETERS

(L. C. Card No. Mic 59-2270)

Richard Frederick Schwartz, Ph.D.
University of Pennsylvania, 1959

Supervisor: Pietro P. Lombardini

While the literature on non-uniform or inhomogeneous transmission lines is very extensive, there is a great deal of repetition and an over-emphasis on "ideal", i.e. lossless, lines. The problem of extending some of the known methods to more general inhomogeneous lines and a discussion of non-uniform transmission line models for physical problems forms the subject matter of this paper.

In order to make any extension to the theory, the author first reviews the salient points of over one hundred and

fifty references on the subject. The direct application of Laplace Transforms to the inhomogeneous line telegrapher's equations is then discussed, and it is pointed out that while this seldom leads to an easier solution, it can be viewed as one example of a coordinate transformation. The possibility of other coordinate transformations for mathematically converting a given inhomogeneous line into a solvable one is then discussed, and the governing relationships are derived for transformation into an equivalent exponential, Bessel, or Legendre line. It is demonstrated that such transformations are not unique, but that in general an infinite number of possibilities exist.

The resolution of a non-uniform line into A-B-C-D matrices for computational purposes is next discussed, and a way is suggested for improving on this technique by using "deficiency sections", that is, added series or shunt elements to make the transition from 4-pole to 4-pole less abrupt. The scattering matrix description is also presented as a 4-pole formulation having different physical significance than the A-B-C-D method.

In the following section Bolinder's approximate method for determining reflection coefficient is extended to lossy lines by using a Laplace instead of a Fourier transform. The lossy exponential line is worked out as an example of the technique. Generally the addition of loss will make the reflection coefficient of any line less frequency sensitive while raising the minimum value obtainable.

The last part of the paper deals with the use of inhomogeneous line models for the solutions of physical problems, and examples in the fields of quantum mechanics, electron optics, mechanics, and ionospheric propagation are given. Some practical suggestions for the physical realization of such models are made. The author feels that transmission line modeling will become of increasing importance in the future. Microfilm \$2.30; Xerox \$8.00. 175 pages.

ENGINEERING, MECHANICAL

ON THE MECHANISM OF TURBULENT HEAT TRANSFER OF LIQUID METALS FLOWING IN CIRCULAR CONDUITS

(L. C. Card No. Mic 59-2000)

Naim Zaki Azer, Ph.D.
University of Illinois, 1959

A simplified mechanism of turbulent heat transfer, based on a modification of Prandtl's mixing length hypothesis, has been proposed. During the flight of the eddy, its momentum and energy are not assumed constant. Two expressions giving the ratio of eddy diffusivities for heat and momentum were obtained for fully developed pipe flow. The first is valid for relatively high Prandtl number fluids ranging from 0.6 to 15. The second is for liquid metals. Both expressions predict the influence of Reynolds number, Prandtl number and radial location in the pipe on the diffusivity ratio as has been revealed by limited experimental data.

The theoretical expression for diffusivity ratio was used in the computation of temperature profile and Nusselt

number for liquid metals. Both cases of constant wall flux and constant wall temperature were considered. Predicted results agree well with available data.

For practical calculations of film coefficient of heat transfer, two interpolation formulae, deduced from the theoretical results, may be used:

- 1) For constant wall flux

$$Nu = 7 + 0.05 (P_r)^{1/4} (P_e)^{0.77}$$

- 2) For constant wall temperature

$$Nu = 5 + 0.05 (P_r)^{1/4} (P_e)^{0.77}$$

Both formulae fit the data with a maximum deviation of less than 12% for $P_r < 0.1$ and $P_e < 15,000$. Values of Nusselt number for the limiting cases of vanishingly small Prandtl number and infinitely large Reynolds number were also presented. Microfilm \$2.25; Xerox \$8.00. 171 pages.

EFFECT OF LONGITUDINAL PULSATIONS ON HEAT TRANSFER

(L. C. Card No. Mic 59-2479)

Vaikun Chalithban, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Byron Short

The coefficient of heat transfer of pulsating flow of air in a circular pipe was investigated. The test equipment consisted of a counterflow heat exchanger composed of two standard brass pipes. The air side was a 3/4 in. pipe with an 0.824 in. ID with the outside surface machined to 1.000 in. It was installed in a 1-in. pipe jacket. The effective length of the heat exchanger was 7.91 ft. The pulsating air was produced by two compressors with fundamental pulse range of 3 to 15 cycles per second.

Within the range of Reynolds number in the experiment, $7,000 < N_{Re} < 200,000$, the Nusselt number of pulsating flow was found to be a function of Reynolds number and the frequency of pulsation. An increase of as much as 100 per cent was noted in the Nusselt number in the experiment at some point, the location of which was a function of Reynolds number and frequency of pulsation. At a very high Reynolds number the effect of pulsation disappeared for all frequencies within the range covered.

A relationship between the coefficient of heat transfer and the ratio of pressure drop for pulsating flow to that for nonpulsating flow could be predicted by a modified Martinelli equation.

Microfilm \$2.00; Xerox \$5.00. 98 pages.

A SOMMERFELD SOLUTION FOR FINITE JOURNAL BEARINGS WITH CIRCUMFERENTIAL GROOVES

(L. C. Card No. Mic 59-1899)

Joseph Vincent Fedor, Ph.D.
University of Maryland, 1958

Supervisor: Professor Ralph H. Long, Jr.

When classical methods of analysis are applied to solve Reynolds' equation governing full journal bearings with circumferential grooves and operating with a continuous oil film, they lead to a solution that is algebraically complex. A method of solution is developed that circumvents the impasse and leads to equations for journal bearing characteristics that are in finite form. Salient features of the complete oil film solution are: as the eccentricity ratio, b , approaches 1, the load capacities of all finite bearings approach that of the infinite bearing; also, the friction curve intercept, $(r/c)f$, is 1 for all finite bearings when b equals 1. Results are compared with calculated values published by Muskat and Morgan for $0 < b < 0.6$. Excellent agreement is found throughout the compared range.

For the case of low feed pressure and a ruptured oil film ($P(O,z) = P(\pi,z) = 0$), the pressure equation for the complete oil film is integrated over only the positive pressure arc. A method is suggested to by-pass the algebraic difficulties that arise and which gives quasi-exact journal bearing characteristics. These equations are also in finite form. The main features of the quasi-exact solution are: as b approaches 1, friction values are less than those predicted by the complete oil film solution; when b equals 1, the friction curve intercept is zero for all finite bearings. For b near 1, load capacities are greater than the load capacities for the complete oil film case. Journal bearing characteristic curves are compared with results published by Cameron and Wood. Good agreement is found despite the different boundary conditions used.

Microfilm \$2.00; Xerox \$3.00. 51 pages.

PERIODIC FLUID FLOW IN RIGID AND FLEXIBLE TUBES

(L. C. Card No. Mic 59-1642)

Elfred John Roschke, Ph.D.
Purdue University, 1959

Major Professor: R. C. Binder

A relatively extensive literature survey has been made covering the periodic flow of an incompressible fluid in rigid and flexible tubes. This survey covers both the theoretical aspects and the available experimental data concerning periodic pipe flow. A brief discussion of the current theory and related physical phenomena has been given.

Descriptions are given of the apparatus and instrumentation used to study periodic flow. A discussion of the flowmeters now available for this type of work has been given and the bristle-type flowmeter has been discussed

in detail. The performance of the apparatus and instrumentation has been discussed in general terms.

The results of a limited experimental program are presented and discussed. This program involved the periodic flow of water through four test sections, all approximately six feet long. Three of these test sections were made of transparent plastic and one was made of thin rubber. Periodic flow was produced mechanically and superposed on an already existing average flow. The factors which were varied experimentally were the frequency and amplitude of the pressure wave, the mean volume flow rate, and the tube diameter. Both numerical data and visually observed physical phenomena are presented and discussed. An effort was made to calculate volume flow from the time-differential of experimentally determined pressure recordings. The results of these calculations are given and discussed.

Microfilm \$2.00; Xerox \$6.80. 145 pages.

THE EFFECT OF VIBRATION ON HEAT TRANSFER COEFFICIENTS

(L. C. Card No. Mic 59-2328)

Yaw Tzong Tsui, Ph.D.

The Ohio State University, 1953

The purpose of the investigation is to study the effects of vibration on the heat transfer coefficient for a transversely vibrating heated vertical plate in free convection with air as the surrounding medium.

Analytical Study

The mathematical analysis is carried out under six assumptions. (1) The flow is laminar and incompressible. (2) The amplitude of vibration, or the frequency, or both are very small. (3) The properties of air are constant. (4) $T_w - T_o \ll T_o$. The dissipation effect is neglected. (5) The air obeys the perfect gas law. (6) The thickness of the velocity boundary layer is equal to that of the temperature boundary layer.

With boundary layer approximations the governing differential equations pertaining to this problem are:

$$(1) \frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0$$

$$(2) \frac{\partial u}{\partial t} + u \frac{\partial u}{\partial x} + v \frac{\partial u}{\partial y} = g \frac{T - T_o}{T_o} - \nu \frac{\partial^2 u}{\partial y^2}$$

$$(3) \frac{\partial T}{\partial t} + u \frac{\partial T}{\partial x} + v \frac{\partial T}{\partial y} = \alpha \frac{\partial^2 T}{\partial y^2}$$

with the boundary conditions:

$$u = 0, v = y_o \omega \cos \omega t, T = T_w \quad \text{at } y = y_o \sin \omega t$$

$$u = 0 \quad T = T_o \quad \text{at } y = y_o \sin \omega t + \delta$$

Then the problem is to find a simultaneous solution which will satisfy equations (1), (2), and (3), as well as the boundary conditions.

Two courses are open to us to attack this problem. One is the exact method which introduces a new independent

variable so that the set of partial differential equations may be reduced to another set of total differential equations which can be integrated numerically, as Pohlhausen¹ did for the stationary heated vertical plate in free convection with air as the surrounding medium. The other is the approximate method which makes use of momentum and energy integrals by assuming plausible velocity and temperature profiles in the boundary layer, as Squire² did for the same plate.

It is shown that in the fixed frame both the exact and approximate methods do not work for the transversely vibrating heated vertical plate in free convection. When the moving frame attached to the transversely vibrating plate is adopted, the exact method still does not work. But the approximate method simplifies the momentum and energy integrals

$$\frac{\partial}{\partial t} \int_0^{\delta'} \rho u' dy' + \frac{\partial}{\partial x'} \int_0^{\delta'} \rho u'^2 dy' = g \int_0^{\delta'} \rho \frac{T - T_o}{T_o} dy' - \mu \left(\frac{\partial u'}{\partial y'} \right)_{y'=0}$$

$$\frac{\partial}{\partial t} \int_0^{\delta'} \rho T dy' + \frac{\partial}{\partial x'} \int_0^{\delta'} \rho u' T dy' - T_o \left(\frac{\partial}{\partial t} \int_0^{\delta'} \rho dy' + \frac{\partial}{\partial x'} \int_0^{\delta'} \rho u' dy' \right)$$

$$= - \frac{k}{c_p} \left(\frac{\partial T}{\partial y'} \right)_{y'=0} = 0$$

to the following set of partial differential equations

$$(6) \left(\frac{1}{12} - \frac{T_w - T_o}{30 T_o} \right) \frac{\partial}{\partial t} (u'_1 \delta') + \frac{\partial}{\partial x'} \left(\frac{u'^2_1 \delta'}{105} \right)$$

$$= g \frac{T_w - T_o}{T_o} \frac{\delta'}{3} - \frac{\nu u'_1}{\delta'}$$

$$(7) \frac{T_w - T_o}{3 T_o} \frac{\partial \delta'}{\partial t} + \frac{\partial}{\partial x'} \left(\frac{u'_1 \delta'}{30} \right) = \frac{2\alpha}{\delta'}$$

by assuming the plausible velocity and temperature profiles in the boundary layer as follows:

$$(8) u' = u'_1 \frac{y'}{\delta'} \left(1 - \frac{y'}{\delta'} \right)^2$$

$$(9) \frac{T}{T_o} = 1 + \left(\frac{T_w - T_o}{T_o} \right) \left(1 - \frac{y'}{\delta'} \right)^2$$

where $u'_1 = u'_1(x', t)$ and $\delta' = \delta'(x', t)$.

The difficulty arises in obtaining the solution of the set of two partial differential equations (6) and (7). Since the problem of a transversely vibrating heated vertical plate in free convection is not suitable to analytical treatment, it seems to be advisable to attack this problem from the experimental side.

Test Apparatus

Heat transfer determinations may be made from a knowledge of the temperature distribution in the fluid near the surface of the plate transferring heat. Optical methods have been used to good advantage. Since they work without inertia, they permit one to investigate processes which vary rapidly with time. Another advantage is that they do not disturb the field under investigation. Furthermore,

they permit the determination of the entire temperature field around the plate, and, since air does not absorb radiation, corrections for radiation are unnecessary.

A Zehnder-Mach interferometer³ was used to collect the data for the study. A view of this instrument with the test apparatus and auxiliary equipment is shown in Figure 1. A 4" x 5" Speed Graphic camera without lens was employed to take interference photographs.

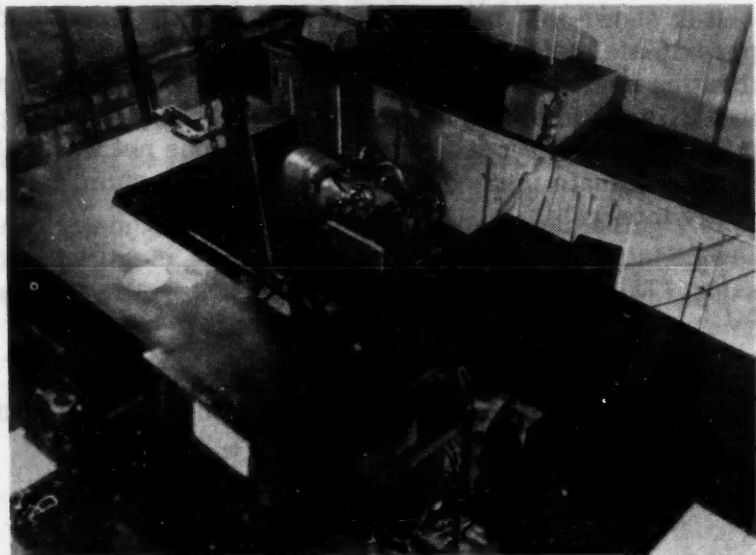


Fig. 1

General View of Zehnder-Mach Interferometer With Test Apparatus and Other Measuring Instruments

The heat transfer system studied in this investigation was that of a transversely vibrating heated vertical plate transmitting heat to the surrounding air through free convection. The vibrating plate was composed of two layers, one, aluminum, having dimensions $3/16"$ x $5"$ x $10"$, and the other, transite, $1/2"$ x $5"$ x $10"$. These plates were screwed together but insulated electrically from each other by placing a sheet of fish-paper between them. Three resistance wire circuits were embedded in the grooves cut on the transite plate to form the heat source, and a set of twenty iron-constantan thermocouples were pinned on the back side of the aluminum plate for temperature measurement. The transversely simple harmonic oscillation was obtained through an eccentric cam and flat plate follower mechanism. A composite eccentric cam was employed so that the amplitude of vibration could be varied from $0"$ to $0.02"$. A preloaded heavy helical spring was placed between the flat plate follower and the bearing so that it would keep the eccentric cam and the flat plate follower in contact at any phase position. A variable speed motor was used as the driving motor. Figure 2 shows the general view of the test apparatus.

Test Scope and Procedure

Throughout the test, the temperature difference between the plate and the ambient air was kept at about 95°F . except on two occasions. The variations of the amplitude of vibration were $0.003"$, $0.009"$, and $0.016"$. At each specified amplitude of vibration the frequencies were varied as follows: 3 cps, 5 cps, 10 cps, 15 cps and 20 cps. For each specified amplitude and frequency of vibration, eight interference photographs were taken corresponding to eight

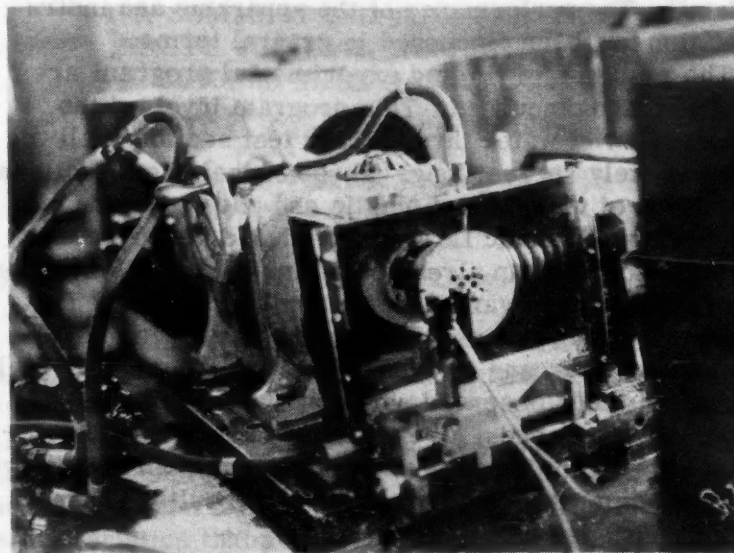


Fig. 2

General View of Test Apparatus

phase positions. All interference photographs were exposed to $1/1000$ second with $4" \times 5"$ Kodak super ortho-press sheet film. The camera focal plane shutter was opened with a solenoid. The solenoid was energized when a normally open microswitch was closed by an actuating screw on the timing wheel fastened to the eccentric cam shaft at the desired phase position. The time delay between the instant of closing the normally open microswitch and that of taking the interference photograph was recorded on the recording oscillograph. A typical interference photograph is shown in Figure 3.

Test Data and Results

The zero fringe method was employed throughout the experiment. Since the pressure variations were neglected,

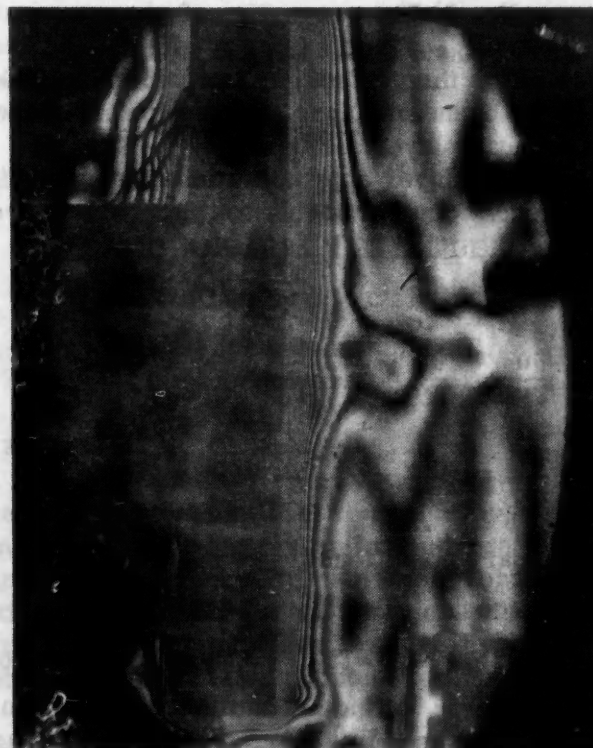


Fig. 3

Typical Interference Photograph

these fringes represented isothermal lines. The end effect was also neglected. Fringe measurements were made on a specially built optical comparator at five sections, 0.305", 1.281", 2.500", 3.721", and 4.697" from the lower edge of the plate. From these fringe measurement data the temperature distributions near the plate at the five sections were plotted. Then the local heat transfer coefficient were obtained through the formula:

$$(10) \quad h_x = \frac{k_w}{\delta}$$

The local heat transfer coefficients were plotted against phase positions. Since eight interference photographs were taken for each specified amplitude and frequency, the local phase average heat transfer coefficient \bar{h}_{px} were obtained by averaging eight local heat transfer coefficients. These \bar{h}_{px} , as well as h_x , the local heat transfer coefficients for a stationary plate at the same test conditions, were plotted against the plate height. A typical one is shown in Figure 4. These \bar{h}_{px} , as well as h_x vs. x plots, were integrated by means of a planimeter, and the average values were obtained.

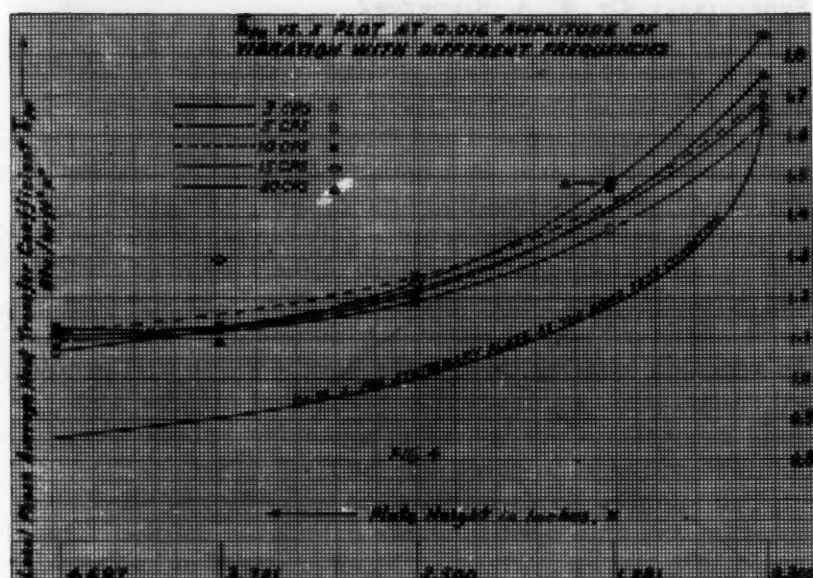


Fig. 4

Since the unsteady state terms appear in the governing differential equations, the conventional correlation of free convection heat transfer data through three dimensionless numbers Nu , σ , and Gr does not apply to this case, even if the flow remains laminar. Nevertheless, the term $\log Nu_x$ computed from \bar{h}_{px} as well as $\log Nu_x$ for the stationary plate at the same test conditions was plotted against $\log Gr_x$. It was found that for the transversely vibrating plate the slope of $\log Nu_x$ vs. $\log Gr_x$ plots varies from 0.2743 to 0.2925.

Summary of Findings

(1) The phase position has a great bearing on the local heat transfer coefficient h_x .

(2) In general, the phase average local heat transfer coefficient \bar{h}_{px} from 180° to 360° (that is, when the plate oscillates forward) appears to be greater than \bar{h}_{px} from 0° to 180° (that is, when the plate oscillates backward).

(3) For any fixed frequency of vibration, there is an optimum amplitude of vibration of .009".

(4) For a fixed amplitude of vibration, the optimum

frequency varies with the amplitude. For $e = 0.016"$, $f = 15$ cps; $e = 0.009"$, $f = 10$ cps; $e = 0.003"$, $f = 3$ cps.

(5) The most optimum case occurs at $e = 0.009"$ and $f = 10$ cps with a 24.1 per cent increase in \bar{h}_{px} over \bar{h}_x of the corresponding stationary heated plate. In other words, the total heat transfer from the plate is increased by 24.1 per cent.

(6) The effect of the amplitude of vibration on \bar{h}_{px} appears to be greater than that of the frequency of vibration on \bar{h}_{px} .

(7) The plate temperature does not remain constant when the plate is vibrated. The maximum variation of the plate temperature from one section to another is 12°F .

(8) The flow pertaining to this study seems to be transitional.

List of Symbols

e	Amplitude of vibration, in.
g	Gravitational acceleration, ft. sec. ⁻²
Gr	Grashof number, dimensionless
Gr_x	Local Grashof number, dimensionless
h	Heat transfer coefficient, b. hr. ⁻¹ ft. ⁻² °F. ⁻¹
h_x	Local heat transfer coefficient, b. hr. ⁻¹ ft. ⁻² °F. ⁻¹
\bar{h}_{px}	Local phase average heat transfer coefficient, b. hr. ⁻¹ ft. ⁻² °F. ⁻¹
\bar{h}_{px}	Average heat transfer coefficient with respect to phase and plate height, b. hr. ⁻¹ ft. ⁻² °F. ⁻¹
k	Thermal conductivity, b. hr. ⁻¹ ft. ⁻¹ °F. ⁻¹
k_w	Thermal conductivity at wall temperature, b. hr. ⁻¹ ft. ⁻¹ °F. ⁻¹
Nu	Nusselt number, dimensionless
Nu_x	Local Nusselt number, dimensionless
T	Air temperature in boundary layer, °R
T_o	Ambient air temperature, °R
T_w	Wall temperature, °R
t	Time, sec.
u, v, w	Velocity components in fixed frame, ft. sec. ⁻¹
u', v', w'	Velocity components in moving frame, ft. sec. ⁻¹
x	Distance measured from the lower edge of the plate, in.
x, y, z	Fixed frame coordinates
x', y', z'	Moving frame coordinates
y	Distance between plate and fringe, in.
y_o	Amplitude of vibration, ft.
α	Thermal diffusivity, ft. ² hr. ⁻¹
δ	Subtangent of temperature profile, ft.
δ	Boundary layer thickness in fixed frame, ft.
δ'	Boundary layer thickness in moving frame, ft.
μ	Dynamic viscosity, lb. hr. ft. ⁻²

ν	Kinematic viscosity, ft. ² hr. ⁻¹
ρ	Density, slug ft. ⁻³
σ	Prandtl number, dimensionless
ω	Angular velocity, rad. sec. ⁻¹
Microfilm \$2.35; Xerox \$8.20. 178 pages.	

1. Goldstein, S. *Modern Developments in Fluid Dynamics*, Oxford: Clarendon Press, 1938, II, pp. 638-639.
2. Goldstein, II, pp. 641-643.
3. Eckert, E. R. G., Drake, R. M., and Soehngen, E. "Design and Construction of an Interferometer," Air Force Technical Report No. 5721.

Abstract published by special arrangement with The Ohio State University.

AN INVESTIGATION OF THE HEAT TRANSFER AND RECOVERY FACTORS FOR A ROTATING DISK

(L. C. Card No. Mic 59-1657)

Frank Richard Zaloudek, Ph.D.
Purdue University, 1959

Major Professor: R. J. Grosh

The aerodynamic and thermal considerations involved with the laminar flow regime occurring about a free disk rotating in its own plane has been extensively studied in the past by various investigators because this is one of the few configurations which allows an exact solution of the Navier-Stokes equations. However, the recent trend to high-speed rotating machinery components has necessitated further investigations into the turbulent region. Turbulent flow patterns as hypothesized by von Karman and Goldstein have been partially confirmed experimentally by the work of Gregory, Stewart and Walker, Welsh, and others; heat transfer estimates based on these considerations and on analogy methods have been published by Krieth and Taylor. Cobb and Saunders investigated experimentally the turbulent flow regime for the case of an isothermal surface condition.

The present work describes an experimental investigation of the turbulent heat transfer problem considering a constant heat flux condition at Reynolds numbers ranging from the transition to 2×10^6 . Because of the high speed nature of the flow, it was necessary to devote a phase of the experimentation to the determination of recovery factors. An attempt was made to deduce recovery factor information theoretically by employing a modification of Ackerman's method. The results were found to be a function of Prandtl number and were well substantiated by experiment.

The apparatus employed in the experimental phases of this investigation consisted of an upward facing circular plate 16 inches in diameter constrained to rotate about a vertical axis. The use of true surface heaters and the application of two separate independent methods of ascertaining surface temperatures minimized the usual inaccuracies present in an investigation of this type.

Values for the local heat transfer coefficient as determined experimentally were found to obey the empirical law

$$Nu = 0.0279 Re^{.8} Pr^{.33}$$

which closely corresponds to the analogy method prediction of Krieth and Taylor. During the course of experimentation, observations regarding the effects of various degrees of "wobble" imposed on the test section suggested a possible future experimental extension of the present work to include the effects of variable surface conditions. Microfilm \$2.00; Xerox \$5.60. 113 pages.

ENGINEERING MECHANICS

THE TRANSIENT RESPONSE OF A BEAM WITH TIME DEPENDENT BOUNDARY CONDITIONS

(L. C. Card No. Mic 59-2481)

Joseph Winthrop Dalley, Ph.D.
The University of Texas, 1959

Supervisor: Dr. E. A. Ripperger

If a moment is suddenly applied to one end of a finite beam, a flexural wave results which propagates along the beam to the unloaded end and then is reflected back and forth between the ends in a manner dictated by the boundary conditions. Eventually some steady state stress condition will prevail in the beam. This dissertation is concerned with the determination of the transient strain and deflection in a beam after reflection from the boundaries occur but before the steady state condition prevails. An adequate existing theory was sought which will predict with reasonable accuracy these transient strains and displacements. Corresponding measured values were obtained and used to check the theory.

The Mindlin-Goodman solution to the Bernoulli-Euler equation was employed to obtain calculated values. The expression for strain thus obtained contains an infinite series which does not converge rapidly enough to be useful. Therefore, finite difference equations are employed to obtain strain values from calculated deflections.

The laboratory model used consisted of a simply supported beam with a suitable arrangement to suddenly apply a moment to one end. The transient strains were measured at six stations along the bar. Transient lateral displacements were measured at two stations.

The calculated strains showed no agreement with the corresponding measured values. Better agreement was obtained between measured and calculated displacements.

On the basis of this investigation it was concluded that: (1) Although the Mindlin-Goodman theory correctly predicts the general shape of the elastic curve, the displacement magnitudes cannot be accurately determined using 5-place floating point arithmetic. (2) It appears unlikely that usable strain values can be obtained by this method, even with the use of double precision arithmetic on a computer. (3) Practical considerations make it necessary to use a high speed, electronic, digital computer to obtain deflection values from the Mindlin-Goodman solution. (4) Even for a relatively simple structure and loading, the solution is more cumbersome and complicated than is consistent with ordinary engineering usage.

Recommendations are made for further study of this problem. Microfilm \$2.00; Xerox \$5.60. 113 pages.

SOME PROBLEMS IN HORIZONTAL TWO-PHASE TWO-COMPONENT FLOW

(L. C. Card No. Mic 59-1640)

Bobbie Leon Richardson, Ph.D.
Purdue University, 1959

Major Professor: E. A. Trabant

An experimental investigation was conducted on the flow of air-water mixtures in a number of horizontal rectangular Lucite test sections, whose aspect ratios varied from two to sixteen. These test sections were assembled in various combinations to permit the study of the effect of a sudden change in flow area on the significant flow parameters.

A technique was developed for measuring the volume fraction of each phase, making use of the difference of the attenuation characteristics of the liquid and the vapor for gamma radiation. This technique was evaluated making use of a number of Lucite mockups with known void distributions.

Information is presented on the factors influencing the volume fractions, flow patterns and slip ratios in the channels studied. The two-phase pressure drop is compared with existing correlations, and a relationship predicting this pressure drop, in terms of the liquid volume fraction, is derived.

The energy losses associated with an abrupt expansion or contraction were studied. A correlation based on the experimental results is presented to permit the prediction of these losses. Microfilm \$2.00; Xerox \$7.00. 149 pages.

STRESS-STRAIN CHARACTERISTICS OF METALS AT HIGH STRAIN RATES

(L. C. Card No. Mic 59-2498)

James William Turnbow, Ph.D.
The University of Texas, 1959

Supervisor: Dr. E. A. Ripperger

When a metal rod is subjected to a longitudinal impact large enough to produce stresses at the point of impact in excess of the elastic limit of the material, a complex stress wave is propagated along the bar. A part of the wave is elastic, but a second part, the excess stress above the elastic limit, is propagated as a plastic wave at a velocity which apparently may differ from that of the elastic wave. The existing elementary theories pertaining to the problem, as well as certain experimental results, are not in agreement on this point. In order to resolve these differences, there is a need for accurate dynamic stress-strain data for various materials. These data, when used to formulate dynamic stress-strain laws, will permit a closer study of the validity of each of the present theories of von Karman, Taylor, and Malvern, and will provide criteria for modifying them if further discrepancies remain between theory and experiment.

Complete stress-strain diagrams obtained under conditions of constant strain rate are especially required in order to establish the effect of strain rate upon the dynamic

stress-strain law. A brief survey is thus made of the experimental techniques which have been employed in the past for measuring transient loads and strains and for deducing the strain-rate effects. Based on the assumptions made in these previous methods and the results obtained from them, a direct method of recording simultaneously the stress-time and strain-time curves was chosen and impact tests were conducted on short, hollow cylinders of aluminum and copper at strain rates from 40 to 1600 in./in./sec. The method did not permit the establishing of complete stress-strain diagrams, but the ultimate stresses and elastic moduli were obtained and have been presented as functions of strain rate.

It is concluded from the experimental investigation that: (1) The ultimate stress for 6061-T6 aluminum alloy cylinders increases approximately uniformly with increase in strain rate at about 5.4 psi per in./in./sec. (2) The ultimate stress for the copper increases from the static test value of 49,400 psi to 60,000 psi at a strain rate of 200 in./in./sec. From this point, the stress then increases uniformly at about 4.5 psi per in./in./sec. (3) Great care must be taken to insure planeness of impact when the ratio of the length to diameter of the specimen is small, otherwise test results may vary widely. (4) The basic method used does not give the complete stress-strain diagram because of difficulties of interpretation of the test records in the vicinity of the elastic limit stress. (5) A second method, used for the 1600 in./in./sec. strain rates, offers more promise for further development.

Tentative results showing a decrease in the effective elastic moduli with increase in strain rate are presented with reservations. Recommendations for further study of the problem are outlined.

Microfilm \$2.45; Xerox \$8.60. 187 pages.

ENGINEERING, METALLURGY

THE TWINNING BEHAVIOR OF Au-Cd ALLOYS

(L. C. Card No. Mic 59-2006)

Howard Kent Birnbaum, Ph.D.
University of Illinois, 1959

The crystallography of transformation and mechanical twinning in the orthorhombic β' and tetragonal β'' Au-Cd alloys was studied. The conditions for twin intersection were determined. The accommodation of twins in these structures occurred by elastic distortion of the matrix and the twin.

The deformation of the β' and the β'' alloys was shown to occur by the stress induced motion of the twin boundaries. The motion of the twin boundaries through the crystal did not cause any plastic deformation. A restoring force was observed to act on the displaced boundaries as a result of an increase in the internal energy of the volume of the crystal through which the boundaries were displaced. The stress required for boundary motion and the restoring force were directly related to the strain rate and inversely related to the temperature. The stress required for the twin boundary motion decreased as the boundaries were

repeatedly displaced through the same volume of the crystal; the effect increasing at low temperatures. The restoring force and the stress for boundary motion were shown to depend on the previous thermal history of the specimen. The restoring force on the displaced boundaries decreased as the boundaries were held in their displaced positions. A mechanism for twin nucleation, twin boundary motion and the restoring force was proposed on the basis of the experimental results.

The transformation twin boundary stabilization processes were studied as the specimens annealed after transformation. The stress for twin boundary motion and the restoring force increased with time after transformation at a rate which depended on the temperature of holding and the prior history of the specimen.

The stress for mechanical twinning in these alloys exhibited a stabilization behavior similar to that of the transformation twins. The rate of this stabilization after transformation decreased as the impurity content of the crystals increased. The conditions for the formation of a mechanical twin orientation in the presence of two transformation twin orientations were examined.

Microfilm \$2.00; Xerox \$7.20. 152 pages.

LOW TEMPERATURE SPECIFIC HEATS OF SOME BINARY ALLOYS OF TRANSITION METALS

(L. C. Card No. Mic 59-2012)

Chin-Huan Cheng, Ph.D.
University of Illinois, 1959

The specific heats of nine alloys of transition elements in the first long period were measured in the temperature range of 1.4° to 4.2°K. The experimental equipment and procedure are fully described. Three vanadium alloys were prepared by arc melting and six manganese alloys by induction melting. The composition of the alloys were $\text{Ti}_{0.5}\text{V}_{0.5}$, $\text{V}_{0.5}\text{Cr}_{0.5}$, $\text{Fe}_{0.33}\text{V}_{0.67}$, $\text{Cr}_{0.9}\text{Mn}_{0.1}$, $\text{Cr}_{0.8}\text{Mn}_{0.2}$, $\text{Cr}_{0.7}\text{Mn}_{0.3}$, $\text{Cr}_{0.6}\text{Mn}_{0.4}$, $\text{Fe}_{0.55}\text{Mn}_{0.45}$, $\text{Fe}_{0.53}\text{Mn}_{0.43}\text{Co}_{0.04}$. The first seven alloys had body-centered cubic structure, and the last two face-centered cubic. All alloys, except $\text{Ti}_{0.5}\text{V}_{0.5}$, were nonsuperconductive in the temperature range of the measurements.

For each of the nonsuperconductive alloys, the electronic term of the specific heat could be separated from the lattice term by the conventional C/T vs T^2 plot, while the electronic specific heat coefficient of the $\text{Ti}_{0.5}\text{V}_{0.5}$ alloy in the normal state was calculated from its entropy at the superconductive transition temperature. The density of state at the Fermi level and the Debye characteristic temperature of each alloy were derived from the specific heat data. The accuracy of the measurements was estimated to be about $\pm 2\%$.

It was found that the electronic specific heat of the four b.c.c. Cr-Mn alloys increased rapidly with the increasing manganese content up to 40 at% Mn. An analogous rise in electronic specific heat was also found in a series of Cr-Fe alloys at corresponding electron concentrations. It appears probable that the phenomenon may be interpreted in the usual way in terms of high density of states at the Fermi level. The two f.c.c. Fe-Mn alloys, the one with and the other without carbon, showed no measurable difference in their specific heats; the effect of 4 at% carbon in

interstitial positions was apparently insignificant upon the specific heat.

By combining the γ values obtained in the present work with those for the five first long period transition elements and three alloys investigated by others, in the electron concentration range studied in the present work, the γ vs composition curve from titanium to iron was plotted. A possible high peak in γ for the f.c.c. structure, analogous to the one found for the b.c.c. structure, was expected to be in the region between Fe and $\text{Fe}_{0.55}\text{Mn}_{0.45}$.

Microfilm \$2.00; Xerox \$5.20. 103 pages.

THE FUNCTION OF ALIPHATIC ACIDS IN FLOTATION COLLECTION

(L. C. Card No. Mic 59-2376)

Hyung Sup Choi, Ph.D.
University of Minnesota, 1958

Adviser: S. R. B. Cooke

This thesis deals with the function of various aliphatic acids as flotation collectors. To investigate the effects of the structures and degrees of unsaturation of different fatty acids, flotation tests were made on iron ores at different pH values and collector concentrations. Selective flotation, both of iron oxides from quartz and of calcium-activated quartz from iron oxides, was performed.

Simplified flotation tests using hematite, goethite and activated quartz were made in the Hallimond tube, and the results were correlated with those of the larger-scale flotation tests.

Hallimond tube tests and contact angle measurements on calcium-activated quartz show that collectability increases with increasing degree of unsaturation, and also depends upon the structure of the fatty acid collector. The increase in collectability gained by increasing the unsaturation of the collector is explained in part by differences in the solubility products of the respective calcium or magnesium soaps, and in part by the effective surface coverage given by the additional double bonds in the fatty acids.

The results obtained by the flotation of hematite and goethite in the Hallimond tube indicate a close correlation between the electrochemical properties of hematite and goethite and their flotation characteristics. Since hydrogen and hydroxyl ions are potential-determining ions for these two iron oxide minerals, the hydrogen ion concentration, through its control of the surface potential, has a profound effect on collection with fatty acids.

The frothing characteristics of various fatty acids were studied as functions of their structure, of pH and of the temperature of the pulp. The results accounted for the flotation behavior of iron ores in the acid range.

The effect of temperature on the anionic flotation of the iron oxide minerals and of activated quartz was investigated in detail by means of contact angle measurements and Hallimond tube tests. It is concluded that the remarkable improvement obtained in the flotation of iron ores at elevated temperature is due to modification of frothing characteristics; to increase in the solubility of the fatty acids; and to increase in film residence rate.

Microfilm \$2.65; Xerox \$9.20. 203 pages.

FATIGUE PROPERTIES OF HIGH STRENGTH STEELS

(L. C. Card No. Mic 59-1902)

Henry Eric Frankel, Ph.D.
University of Maryland, 1958

Supervisor: Professor William A. Pennington

Although the necessity for the utilization of statistical techniques in interpreting fatigue data is now clearly recognized, the fundamental metallurgical aspects of the problem still are not well understood. Accordingly, the National Bureau of Standards and the University of Maryland undertook a program designed to study and evaluate a number of the fundamental factors which may affect the fatigue properties of high strength steels.

Using four alloy steels whose carbon contents represented a range of 0.4% - 1.0%, the influence of the following factors was studied: tempering temperature, hardness, retained austenite, method of cooling for hardening, and refrigeration. As many of these variables are inter-related, experimental plans utilizing factorial replication means were employed. A technique for specimen preparation which does not mask any metallurgical surface changes was devised.

It was shown that fatigue strength, as measured by rotating beam cyclic stressing, is a linear function of hardness up to a limiting value which depends on the carbon content. Retained austenite, up to about 10%, was found to be detrimental to the fatigue properties of those steels employed in this investigation. Removal of retained austenite by refrigeration after quenching or by medium temperature tempering or stabilization by tempering improved the fatigue properties. It was also determined that fatigue stressing transforms retained austenite presumably to an untempered martensite. The amount of transformation was found to be a function of the radial distance of the specimen cross-section, the maximum amount of transformation occurring at the outermost fibres and the least amount when the center of the specimen is approached. It was also concluded that as carbon content is increased, greater hardnesses are necessary to attain equal fatigue strengths. Marquenching was shown to give no better results than a quenched and tempered condition. Double tempering, on the other hand, may possibly be of great benefit in improving fatigue resistance.

A phenomenological hypothesis of the effect of retained austenite on the fatigue properties of high strength steels was offered. Microfilm \$2.00; Xerox \$5.40. 107 pages.

EFFECT OF SUBSTRUCTURE AND CARBIDE PRECIPITATE ON THE TENSILE AND IMPACT PROPERTIES OF HIGH PURITY LOW CARBON ALPHA IRON

(L. C. Card No. Mic 59-2247)

Gilbert Julius London, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Norman Brown

The low temperature flow, fracture and impact transition properties of several high purity low carbon-iron alloys have been investigated. The effect of substructure and grain boundary iron carbide precipitate on these properties was determined. An analysis of the effect of substructure, per se, is presented along with data showing some effects of carbon segregation on flow and fracture properties.

It was found that grain boundary iron carbide precipitate in ferrite increases impact transition temperature and decreases fracture stress but has little effect on yield strength.

The interaction of piled up dislocation arrays with grain boundary iron carbide platelets has been proposed to account for the observed effects of grain boundary precipitate.

Carbon segregation at sub-boundaries is proposed to account for observed increases in yield and fracture stresses and decreases in impact transition temperature on approach to saturation within the single phase alpha region of the iron-carbon phase diagram.

It was also observed that the initial effect of the grain boundary precipitate on impact transition temperature was essentially independent of grain size and substructure.

Microfilm \$2.00; Xerox \$5.60. 111 pages.

THE ORDER-DISORDER TRANSFORMATION IN Ni₃Mn

(L. C. Card No. Mic 59-2253)

Marion John Marcinkowski, Ph.D.
University of Pennsylvania, 1959

Supervisor: N. Brown

The present work has been directed toward an understanding of two important features of the ordering transformation. In particular, they are the arrangements of atoms in the intermediate equilibrium states of order and the arrangements of atoms under non-equilibrium conditions prior to the approach to equilibrium. Up to the present time, most of the research in this area has involved a study of the systems AuCu₃ and beta brass, but in spite of this, there is still no general agreement on either the mechanisms involved or the configuration of the atoms present. The alloy Ni₃Mn appears to be a particularly suitable system in which to study these problems, because of the remarkable sensitivity of the magnetic properties to the arrangements of order.

Magnetization was measured from -196°C up to the Curie temperature in an applied field of 100 Oersteds.

This was done for a series of specimens that were quenched from temperatures corresponding to the entire range of equilibrium ordered configurations from complete disorder to nearly perfect order. A second set of similar magnetic measurements were made on specimens that were allowed to transform isothermally from the disordered arrangements to the equilibrium configurations corresponding to a particular temperature. Supplementary measurements employing Neutron diffraction analyses as well as Rockwell "G" hardness measurements were carried out at room temperature for a series of specimens treated in the manner described above. Finally, an X-ray determination was made of the lattice size for specimens ordered to various degrees.

The results show that the magnetization and Curie temperature both increase with increasing order. Samples with intermediate equilibrium degrees of order exhibit two Curie temperatures, both of which increase with decreasing quenching temperatures. The critical ordering temperature, as indicated by these measurements, is 475°C. Isothermal relaxation experiments at 480°C and 425°C cause the Curie temperature to rise continuously. The isothermal anneal at 465°C however, results in the appearance of a second Curie temperature after ten hours. With increasing time, the second Curie temperature continues to rise while the one initially present remains constant at 0°C.

Theoretical calculations based on two different models show that the moments of Ni and Mn may vary with order. The neutron diffraction measurements exhibit a rather rapid increase in S from 0 above 475°C to 1.02 below 400°C. From X-ray measurements, the edge length of the unit cell was found to be equal to 3.589 ± 1 with no difference between the ordered and disordered samples. Calculations have also been made for the relationship between the Curie temperature and the magnetization as a function of the long range order parameter, and are in fair agreement with experiment. A theoretical investigation was made concerning the equilibrium configuration of dislocations in an ordered face-centered cubic lattice. It has been found that the most likely arrangement is one that consists of a group of four partial dislocations, the separation of which is determined both by the energy of an antiphase domain boundary as well as the stacking fault energy.

On the basis of the previous results, the equilibrium configurations of order corresponding to the intermediate temperature most probably involve regions of long range order in a matrix of short range order, giving rise to two distinct Curie temperatures. As the temperature decreases, the long range order within the domains as well as their total volume both increase. At the same time there is a corresponding increase in the degree of short range order within the matrix. The isothermal relaxation from the disordered state to the completely ordered appears to be a homogeneous process, whereas the relaxation to equilibrium for intermediate states is complicated by the coexistence of regions of long range order in a matrix of short range order.

Microfilm \$2.70; Xerox \$9.40. 207 pages.

A STUDY OF THE MECHANISM OF STRESS-CORROSION OF A MAGNESIUM-BASE ALLOY CONTAINING 6% ALUMINUM AND 1% ZINC

(L. C. Card No. Mic 59-2304)

David Kenneth Priest, Ph.D.
The Ohio State University, 1953

The mechanism of stress-corrosion of a magnesium-base alloy, J-1, was investigated. A salt-chromate testing solution (3 per cent NaCl and 3 per cent K_2CrO_4) was used. All tests were carried out at room temperature.

The material tested was either solution-quenched or furnace-cooled from 650°F. Large grained material was prepared by a strain-anneal treatment. Specimen size was $4 \frac{1}{2} \times 3 \frac{3}{16} \times 3 \frac{3}{16}$ inches. These were stressed as cantilever beams by a fixed deflection of the specimen.

Observations of stress-corrosion cracking were made through a microscope, the stressed specimen being placed in a solution container on the microscope stage. Specimens furnace-cooled from 650°F. exhibited intergranular stress-corrosion cracking in the salt-chromate solution. The compound $Mg_{17}Al_{12}$ was present as a grain boundary precipitate in the microstructure of these specimens. This precipitate, cathodic to the matrix material in salt-chromate solutions, was responsible for the intergranular failure.

Specimens solution-quenched in water from 650°F. exhibited transgranular stress-corrosion cracking. No precipitate was observable with a light microscope. Heidenreich, Gerould, and McNulty¹ have found a "fine structure" to be present in solution-quenched samples of this alloy. Their work with the electron microscope indicates that an FeAl compound segregates along what appears to be a single crystallographic plane.

In the present study, transgranular cracks were found to be predominantly along the basal plane of the hexagonal close packed lattice. The crystallographic plane of cracking was determined by stereographic methods applied to very large grained samples. These results may have significant correlation with the previously cited work.

An unstressed electrode of the J-1 alloy was placed into the salt-chromate solution and corrosion current measured between the stress-corrosion specimen and this electrode. Corrosion currents were found to be different for transgranular and intergranular stress-corrosion, indicating in another way that a difference in mechanism exists.

Another electrode of carbon was employed to give cathodic protection to the stress-corrosion specimen. Cathodic protection produced by an impressed current was successful in preventing the start of stress-corrosion and in stopping it after it had been in progress in both furnace-cooled and solution-quenched specimens. This indicates that electrochemical action plays an important and continuous role in both types of stress-corrosion cracking.

Motion picture microscopy of the stress-corrosion process revealed that local plastic deformation accompanied the cracking. Visual observations of the effects of cathodic protection and of crack direction were made by this means.

Stress-corrosion of both furnace-cooled and water-quenched specimens in distilled water resulted in transgranular cracking only.

The pH of the salt-chromate solution did not determine whether transgranular or intergranular stress-corrosion took place as had been previously reported.² Heat treatment determined the type of cracking under these conditions.

The variables of surface treatment, time under load, grain size, and stress level were studied. It was found that abrasion of the tension surface of stress-corrosion specimens after stress was applied prevented stress-corrosion unless very high stresses were employed. This behavior is ascribed to relief of the surface stress by the cold work of abrasion.

Specimens which were stressed for 20 to 40 days prior to testing at stress levels which would ordinarily cause failure did not fail when tested in the salt-chromate solution. It is believed that stress relief was responsible for this behavior.

When the grain size of the J-1 alloy is greater than A.S.T.M. grain size No. 7, transgranular stress-corrosion always occurs in the salt-chromate solution regardless of heat treatment.

Larger values of stress were required for stress-corrosion failure of furnace-cooled specimens than for solution-quenched ones.

The mechanism of transgranular stress-corrosion in the J-1 alloy is believed to be essentially electrochemical in nature. Heidenreich, Gerould, and McNulty¹ have shown that a segregation of cathodic FeAl exists in the solution-quenched condition of this alloy. This segregation appears to occur only on one plane. It has been shown in the present work that transgranular stress-corrosion takes place predominantly along the basal plane. It is reasonable to state, then, that preferential attack occurs along the basal plane due to the one volt potential difference between the FeAl and the solid solution. The function of stress is believed to be that of exposing bare, film-free metal by tearing brought about by stress concentration at the base of the crack. Microfilm \$2.00; Xerox \$5.40. 106 pages.

1. Heidenreich, R. D., Gerould, G. H., and McNulty, R. E. "Electron Metallographic Methods and Some Results for Magnesium Alloys," *Trans. A.I.M.E.*, 70 (1946), pp. 15-36.

2. Mears, R. B., Brown, R. H., and Dix, E. H., "A Generalized Theory of the Stress-Corrosion of Alloys," *Symposium on the Stress-Corrosion Cracking of Metals*, York, Pa.: A.S.T.M.-A.I.M.E., 1944, pp. 323-39.

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ENGINEERING, SANITARY AND MUNICIPAL

STUDIES ON THE COMPACTION OF SLUDGES
RESULTING FROM LIME NEUTRALIZATION OF
DILUTE SULFURIC ACID WASTES

(L. C. Card No. Mic 59-1814)

Samuel Denton Faust, Ph.D.
Rutgers University, 1959

Major Professor: Dr. Harold E. Orford

High calcium and dolomitic quicklime neutralizations of 1 to 10 per cent sulfuric acid industrial wastes precipitate calcium sulfate solids that settle to sludge volumes ranging from 24 to 134 per cent of the original waste volume. The dry solids concentration (i.e., density) of these sludges varied from 3.1 to 9.8 per cent. Sludge volumes and sludge densities from dolomitic lime were lower than high calcium lime sludge volumes and sludge densities at equal acid concentrations. This study investigated gypsum seeding techniques as a means of producing calcium sulfate solids that would settle to lower sludge volumes with higher densities than the unseeded solids.

Calcium sulfate solids are characterized by sludge volume and sludge density after completion of sedimentation. These solids settled rapidly reaching a final volume within 15 to 60 minutes. Various degrees of neutralization by high calcium and dolomitic quicklime within the pH range of 3.0 to 10.0 had no significant effect on the sludge characteristics. Four types of gypsum seed were employed to produce compact sludges. They are as follows: (a) native gypsum - a finely ground powder derived from the naturally occurring alabaster rock, (b) precipitated gypsum - produced from the lime and sulfuric acid reaction, (c) ground precipitated gypsum - a finely ground powder derived from precipitated gypsum, and (d) return sludge - continuous recycling of a calcium sulfate sludge initially seeded with native gypsum. Other investigators had established that it was necessary to add the seed material to the acid before neutralization in order to produce highly compact sludges.

Most of the current study was confined to the compaction of sludges resulting from high calcium and dolomitic quicklime neutralizations of 1 and 2 per cent sulfuric acids. Gypsum seed dosages that effected maximum compaction of sludge solids ranged from 60 to 120 per cent of the dry weight of the solids precipitated from the neutralization reaction. Native gypsum seed dosages produced a 3-fold compaction of a high calcium lime and 2 per cent acid sludge, and a 7-fold compaction when dolomitic lime was used. Precipitated gypsum seed dosages effected a 1- to 2-fold compaction of high calcium lime and 1 per cent acid sludge solids, and a 2- to 3-fold compaction of dolomitic lime and 1 per cent acid solids. Ground precipitated gypsum seed dosages compacted high calcium and dolomitic lime - 1 per cent acid sludges 2.5- and 7-fold. Continuous recycling of a sludge initially seeded with native gypsum produced 3- to 7-fold compaction of high calcium and dolomitic lime - 1 and 2 per cent acid sludges. Return sludge volumes varies from 15 to 55 per cent of the acid volume and contained dry seed dosages equal to 200 to 300 per cent of the dry weight of the solids precipitated from the neutralization reaction.

Unseeded and seeded calcium sulfate sludges were examined microscopically with regard to relative size and crystal habit. It was found that precipitated gypsum precipitated in the absence of a seed material formed acicular and twinned crystal habits. These crystalline forms settled to high sludge volumes and low sludge densities. Native and ground precipitated gypsum solids were relatively smaller and exhibited granular habits. These granular solids settled to low sludge volumes and high sludge densities. Crystal habit was designated; therefore as the factor determining compaction characteristics of calcium sulfate solids upon sedimentation. Absence of the typical acicular habit in seeded sludges indicated that calcium sulfate precipitated from the neutralization reaction had deposited on the native and ground precipitated gypsum seeds, and on the return sludge seed. Deposition of calcium sulfate on the added seed material produced solids that have higher degrees of compaction than acicular and twinned crystal solids upon sedimentation. Microfilm \$3.35; Xerox \$11.40. 258 pages.

DEVELOPMENT OF DESIGN PRINCIPLE FOR DISPOSAL OF REACTOR FUEL WASTE INTO UNDERGROUND SALT CAVITIES

(L. C. Card No. Mic 59-2494)

Shosei Serata, Ph.D.

The University of Texas, 1959

Supervisor: Dr. Earnest F. Gloyne

The safe disposal of reactor fuel wastes is an important problem. One solution is placement of the wastes in underground salt cavities; this dissertation is an investigation of this solution. Upon preliminary analysis, the structural stability of the cavity appeared to be of prime importance. Consequently, investigations were made to evaluate the structural properties of cavities.

Theoretical investigations for spherical and cylindrical cavities included analysis of elastic stress, thermal stress and stress redistribution due to the development of a plastic zone around the cavity. The elastic stress distribution around various forms of cavity openings have been summarized in various diagrams. The problems of temperature distribution and accompanying thermal stress, due to heat emission from the waste, were also studied. The reduction of the cavity volume, the development of the plastic zone, and the resulting stress redistribution around the cavity have been presented as functions of cavity depth, strength of salt and internal pressure. Theoretical analyses have demonstrated that a salt cavity can be designed such that it is structurally stable regardless of its size, form and depth, unless the internal pressure of the cavity exceeds the overburden pressure. Structural equilibrium equations as related to cavity temperature rise, loading condition, and cavity volume reduction have been developed for the purpose of designing the spherical and cylindrical cavities.

In the laboratory experiments, a standard compression testing procedure for salt was developed. By using these standardized testing procedures, fundamental properties of salt such as strength, Young's modulus, Poisson's ratio, strain-hardening and grain effect were determined. Experiments were also conducted for evaluating the effects of tri-axial compression and creep. Further, structural experiments were conducted to determine the effects of radiation, heat, and chemical solutions. To investigate the comprehensive effect of heat, radiation, creep, tri-axial compression, and chemical solution, a testing device was constructed to simulate actual storage conditions.

Actual creep measurements were made in the Grand Saline salt mine in Texas, and the results appear to agree with the theoretical and experimental conclusions.

Based upon the results of these theoretical and experimental investigations, principles have been established for designing salt cavities which can be used for storage of radioactive wastes.

Microfilm \$2.50; Xerox \$8.80. 192 pages.

FINE ARTS

STUDIES ON SILLA POTTERY

(L. C. Card No. Mic 59-2447)

Won-Yong Kim, Ph.D.

New York University, 1959

Adviser: Dr. Alfred Salmony

The kingdom of Silla existed in Korea from 57 B.C. to 935 A.D., although its constitution as a true kingdom dates from the fourth century A.D. The term "Silla pottery" is applied to the hard grey stoneware of the Silla dynasty.

Chapter I comprises a brief survey of the history of Silla and her art. In Chapter II problems in determining the origin of Silla pottery are discussed. Silla pottery was

derived from the Kimhae pottery, which was a developed type of the plain coarse pottery of prehistoric Korea under direct influence from Chinese "mat pattern" pottery such as the Ch'eng Tzu Yai grey pottery II. The evolution from Kimhae to Silla pottery seems to have taken place during the fourth century A.D.

The stylistic development and absolute dates of various regional groups of Silla pottery are discussed in Chapter III.

The evolution of Silla pottery is divided into two periods:

The First Period (fourth, fifth, and sixth centuries A.D.) of Silla pottery is divided into two main pottery groups--Silla proper and Kaya. Kaya was an area in the western part of the kingdom of Silla before Silla's unification of all Korea in the mid-seventh century A.D. The two pottery groups show differences in details of shape and decorations.

Silla proper pottery consists of several regional groups, such as Talsong, Kyongju, Yangsan, Songju, and Ch'angnyong. Kaya pottery includes the Kimhae group, Haman group, Koryong group, and Chinju group. Differences can be noticed among vessels from these various pottery centers.

During the first period Silla pottery influenced Paekche pottery. Paekche was a kingdom that lay in the west of Silla from 18 B.C. to 660 A.D.

The Second Period (seventh, eighth, ninth, and tenth centuries A.D.) of Silla pottery is very different from the first period. Kaya pottery is absorbed into the Silla proper pottery. The typical pottery shapes of the Silla pottery of the first period give way to new pottery shapes, and the incised geometrical designs on the pottery of the first period are replaced by imprinted floral patterns. The pottery itself also loses the hardness which was a feature of the first period pottery.

Microfilm \$3.10; Xerox \$10.60. 237 pages.

**THE NEW YORK THEATRE; ITS BACKGROUND
AND ARCHITECTURAL DEVELOPMENT: 1750-1853
(VOLUMES 1 AND 2)**

(L. C. Card No. Mic 59-2310)

Stanley T. Lewis, Ph.D.
The Ohio State University, 1953

The dissertation is an historical documentation of the theatres of New York City from 1750 to 1853. It discusses their backgrounds, their architectural trends, and their relationships with contemporary meeting halls, exhibition structures, educational institutions, and other public buildings which serve to clarify the early development of modern centres of popular culture. As most of the buildings discussed are no longer extant, the research has been based on the examination of original architectural drawings, official municipal records, legal documents, personal statements in contemporary diaries, memoirs and letters, and published newspapers and journals.

The theatres of New York were created against the variegated backdrop of the swiftly moving panorama of American cultural development. The general reliance on the inspiration of European traditions, increasingly transformed by native ingenuity for adaptation; the willingness and capacity of the enterprising theatrical promotor to gamble for large stakes; the almost invariable fate of the destruction of theatre structures by fire, yet their phoenix-like resurrection from the flames with ever brighter and grander prospects; the spirit of determined individualism which expanded the nation's frontiers, equally fostering, in the face of severe opposition, a valiant and optimistic outlook for the future of the theatre; the undying popular quest for entertainment and amusement; and the ardent demands of a rising intelligentsia—all combined to form a rich and colorful setting.

Because New York was one of the new country's leading cultural centres, in some respects its most advanced, the theatre forms of New York are of great significance, both intrinsically and in relation to the general development of American art. The attention of the present study has been focused upon the creations of one city because of the nature

and needs of current theatrical research scholarship. At the present time the theatre historian does not have complete factual documentation of the physical forms of the theatres of London and Paris, let alone those of Philadelphia and Boston. With the information available today a comparative study of the theatres of various cities during a given period would be far from definitive. Comparative analysis of the theatres of different cities would be unrewarding without full understanding of the background and evolution of individual theatres and their relationship to other contemporary building types and to the cultural framework of the city. What is needed, at this time, is specific source accumulation of data, so that future interpretive and generalized studies will have a foundation of concrete reliability. Pivotal in this direction is the Theatre Collection of the Library of The Ohio State University, where every form of theatrical research material is being classified and made accessible.

During the hundred year period after 1750, New York theatre building followed a coherent, logical pattern. The development consisted of four successive architectural phases: adherence to the British tradition (1750-1800), experimentation with new forms (1800-1825), preoccupation with the heritage of classicism (1825-1840), and, during the final decade, the rise of eclecticism.

The first stage of theatrical development was dominated by derivation from European sources, especially the British modifications of the Continental tradition. The four major New York playhouses of the eighteenth century, The Nassau Street Theatre (1750), the Chapel Street Theatre (1761), the John Street Theatre (1767), and the Park Theatre (1798), designed by Joseph Francois Mangin, were based on the format of the London theatres. The basic pattern of London's Restoration playhouses, which was essentially a compromise with the conventions of the Elizabethan platform stage, served as a vehicle for the emergence of the American theatre's early architectural expression. Within this conservative British tradition, however, and especially within its classical aspects, were the elemental forms that were later organized into a forceful stylistic system.

The theatre was under a twofold attack during this period. The practice of moral condemnation of the theatre, which had its roots in the Rev. Jeremy Collier controversy in London in 1698, was continued with militant persistence by American moralists. Every theatrical venture was accompanied with critical diatribes. Managers attempted to mollify their opponents by repeated charity benefits; surviving account books reveal how slight the operator's financial profits were. In addition to this difficulty was the association, in the popular mind, of the theatre with the forces of monarchy. Contemporary diaries state that the mob destruction of the Chapel Street Theatre in 1766 was instigated by the Sons of Liberty. During the Revolution the John Street Theatre was protected by the Episcopal Church and loyal adherents of the crown. While the city was under occupation the theatre's name was changed to Theatre Royal, and operated by a group of British officers.

The development of New York's early dramatic theatres must be considered in their relationship with the shows of the popular tradition of spectacle display, which during this period were advancing towards the organization format of the modern circus company. There was a marked interaction between the two types of theatrical activity, both in terms of physical forms and modes of presentation.

Contemporary playhouse trends had a pronounced impact on circus structures. The seating arrangement within the amphitheatre generally followed the customary playhouse division into boxes, pit, and gallery. Sometimes a stage, complete with scenery and machines, was provided beyond the ring, and for dramatic performances the ring was boarded up to serve as a floor on the same level as the stage, thus transforming it into a pit. This readily convertible type of structure was well suited to serve the needs of the city's varied interests and tastes.

The circus, on the other hand, had an influence on more permanent buildings in that it served as a preserving medium for continuing interest in the classical amphitheatre, which was to stir the imagination of such an innovator as Alexander Jackson Davis. The circular form was to be experimented with for the construction of auditoriums on phonic principles, a notable example being the Broadway Tabernacle (1835). During this early period the architectural grand styles were not felt to be related to the problems of circus building, the structures being crudely functional. It is not until Franconi's Hippodrome (1853) that there is evidence of overt interest in stylistic borrowing for decorative purposes, and even there the exterior's veneer of Gothicism was not fully integrated with the basic design.

During the first generation of the nineteenth century the British trend lived on, but now, instead of dominating, it became an aspect of a broader picture. This period witnessed rapid developments in the city's theatrical growth, and its architectural character can best be described as one of spirited experimentation. The new requirement was for theatrical centres larger in size and more varied in purpose. Since the popular conception of entertainment was expanding, it now becomes necessary, in order to understand the over-all theatrical development, to include diverse building types.

Mechanics' Hall, built for the General Society of Mechanics and Tradesmen in 1802, was a forerunner of the new meeting places beginning to be needed by growing educational and social demands. Vauxhall and Ranelagh, London's major eighteenth century pleasure gardens, served as the prototypes of New York's gardens of entertainment, the first of which, the Vauxhall Garden, opened in 1805. One of New York's most important display buildings was the Rotunda, founded by John Vanderlyn in 1818 for the presentation of panoramas. One of the first buildings of its type to be dominated by a spirit of classicism, it was a precursor of the Royal Colosseum, which was designed by Decimus Burton and erected in London's Regent's Park in 1824.

The 1821 Park Theatre, designed by Hugh Reinagle, was a deliberate attempt to break away from European precedents. In 1828 a series of classical designs for altering it was executed by Alexander Jackson Davis. The Chatham Garden and Theatre (1822) is extremely significant, for surviving documents afford more insight into its practical functioning than exists for any other theatre of the time. Castle Garden (1824), which was used for all types of theatrical presentations, as well as for meetings and public celebrations, typifies the varied services theatrical buildings had to perform. The records of Calvin Pollard's 1844 reconstruction help clarify the contemporary construction procedures.

The theatres of this generation were not unified by one movement of pronounced stylistic direction. Combinations

of classical elements were introduced, but not as a coherent system. Among the period's most noteworthy achievements was experimentation with the new method of illumination by gas; by 1825 the Chatham was completely lit by it.

During 1825-1840 the already existing classical features of the New York theatre were given additional beauty by becoming part of the progressive stream of classical, and especially Greek, revivalism. It was in studying and being inspired by the forms of a more distant day than eighteenth century England that American theatre artists evolved the first articulate American theatre formula. The classical movement in New York produced theatres somewhat bolder in conception than those of London, for in America there had been no previous dominating tradition of theatre building native in origin and character. The experiments of the century's first generation helped popularize the classical vocabulary, and its highlights, the Park (1821) and Chatham (1824) interiors, border on the new period.

The second generation of the century witnessed, in New York, the rise of a popular interest in architecture, stirred by a sense of civic pride in the monumental structures which were taking shape throughout the city. It is against the background of an exciting intellectual milieu, largely created by the cosmopolitan tastes of a rising wealthy class, and the challenge of the practical need for many public buildings, that classicism came into its own.

Theatrical monuments of this wave of classicism was Ithiel Town's Bowery Theatre (1826), Peter Grain's Lafayette Theatre (1827), Joseph Sera's Bowery Theatre (1828), the National Theatre (1833), the Broadway Tabernacle (1835), Calvin Pollard's National Theatre (1840), and Frederick Diaper's New York Athenaeum (1840). A series of classical designs by Alexander Jackson Davis affords additional insight into the challenges and ideals which fired the imagination of progressive architects.

New York's classicistic theatres possessed a freshness and youthful brightness not frequently met with in revivalistic movements. This classical charm did not last long. From the blending of the building fluency acquired in the execution of the classical works with the impact of new social ideologies, there emerged a new architectural spirit which could not be limited to a single stylistic formula. In popular entertainment centres mid-nineteenth century eclecticism found one of its ideal mediums of expression.

The years 1840-1853 witnessed the resolution of various widespread cultural trends, including the moralistic movement of internationalism, and the revolutionary movement of social reorganization. A manifestation of the new outlook was the rise of the drama of verisimilitude, with its realistic and analytic conception of life. The new drama aesthetics implied a decline in the decorative importance of the architectural setting, for what was not important [view] was the illusion of the environment placed upon the stage. With the improvement in lighting techniques the auditorium could be effectively blacked out during the performance, so that the spectator could forget the theatrical surroundings and concentrate on the glimpse of life set before him. Inherent in this direction was the eventual decline of the artistic significance of the playhouse as an architectural type.

With the playhouse's loss of architectural potency, theatrical building inventiveness was shifted to meeting the demands of other social centre forms: the meeting

hall, newly significant because of the rapid growth of innumerable organizations, including labor unions and reformist societies; the industrial exhibition building, product of internationalism; and the educational institution, born of the popular education movement, one of the nineteenth century idealism's major achievements, and the movement which vitalized all progressive forms. In New York this shift took place during the fourth decade of the century.

The factor which related and gave a coeval spirit to the varied theatrical building types was the binding medium of eclecticism. New York classicism had been the expression of a rising upper-class, sophisticated intelligentsia; eclecticism fitted the tenor of the new expansive age of growing popular movements and industrial giants of capitalism. It is impossible to imagine Peter Cooper's social philosophy memorialized in a classical structure; his eclectic Union building, complicated and somewhat unrecconciled, still reverberates to the many-sided strivings of its founder.

The purism of New York's classicistic theatres could not help but abate under the demands of a new multiplicity of activities, which could be more readily met by a variegated rather than a strictly formal style. The breakdown of the classical mode went hand-in-hand with the decline in creative playhouse conception, and was replaced by an upsurge in new directions.

Barnum's American Museum (1841), which incorporated a theatre with all sorts of exhibition displays, typifies the new outlook's combination of entertainment and edification forms. Other representative structures include Palmo's Opera House (1844), the Broadway Theatre (1847), John M. Trimble's Tripler Hall (1850), Calvin Pollard's Brougham's Lyceum (1850), and Franconi's Hippodrome (1853). A milestone in the history of New York's institutions of popular culture was the erection of the Astor Library (1850), designed by Alexander Saelzer. Indicative of the age was the Library's inclusion of a large meeting hall, a combination which Alexander Jackson Davis had often projected.

The mid-century climax of American entertainment-educational presentation was Carstensen and Gildemeister's industrial exhibition building, the New York Crystal Palace (1853), considered by contemporaries as a *tour de force* of American architecture. The enterprise which best symbolizes the new spirit is the Cooper Union for the Advancement of Science and Art, the construction of which commenced in the year of the Crystal Palace. Its architect was Frederick A. Peterson, who designed it in conjunction with Peter Cooper himself. The building still stands, and today the Cooper Union Forum of free lectures not only reaches the Great Hall's audience, but, by means of modern educational broadcasting techniques, is transmitted throughout the nation. In this way the Union's Hall continues its original function, and the nineteenth century's ideal of popular democratic education lives on.

From the standpoint of today it is easy to scorn the optimism, idealism, and eclecticism of mid-nineteenth century culture, with its unmitigated affirmation of the inevitability of human progress, for all of the ardent movements it called into being failed to bring about the kind of world it dreamed of. It is more challenging to attempt to understand the energetic and inspired forces which motivated all of its complex activities. If eclecticism is condemned for not resolving an organic theatre aesthetics, it

must be realized that this was because the forces of social necessity were in other directions.

Microfilm \$7.60; Xerox \$26.00. 599 pages.

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HOPEWELLIAN FIGURATIVE SCULPTURE

(L. C. Card No. Mic 59-2302)

Robert Elias Myron, Ph.D.
The Ohio State University, 1953

The dissertation attempts to establish and evaluate the art styles in the Hopewellian region. The art of this culture is marked by impressive three-dimensional and two-dimensional carvings representing naturalistic and geometric forms. Since the middle of the nineteenth century innumerable examples have been found in excavations. Housed in museums and institutions, these objects have been briefly described in articles and field reports. No attempt, however, has been made with any degree of detail to analyze and interpret this spectacular art style; certainly its high aesthetic qualities merit such consideration.

Before the arrival of the white man, the Hopewellian peoples achieved cultural and artistic culmination in eastern North America. The two major centers were in the north. Most spectacular were the mound groups in southern Ohio, while the other center was in western Illinois along the Illinois River. An important, but less extensive center was in the Lower Mississippi Valley. Other smaller comparable sites were found in Wisconsin, Indiana, New York, and along the coasts of Florida.

The Ohio peoples were the "great earthwork" builders. They constructed extensive earthworks in combination with burial mounds. The impressive size of many Ohio sites indicates a considerable population and lengthy occupation of the region. The Ohio peoples were organized into a well-integrated society. Their constructions were probably made possible by political organization and large-scale cooperative labor. Their complexity became the standard by which archaeologists have measured Hopewellian sites in other regions.

Culturally and physically, Ohio sites are contemporaneous and very closely related, with a strong feeling for uniformity. Their affinity to Hopewellian sites in other regions is marked by the close similarity of mound construction, manner of interment of the dead, and associated materials and artifact types. The considerable number of varied materials found in the Ohio mounds strongly suggests flourishing trade and cultural relations.

The primary purpose of these exotic materials was probably for ceremonial requirements and subsequent placement with the honored dead in large complex burial mounds. A religious motivation for their acquisition seems plausible, as the materials were closely associated with the burials and many specimens had practically no utilitarian importance or significance.

The elaborate construction and uniform ceremonial of the interment of the dead implies the presence of a priesthood class that established and regulated the rituals. The

high quality and homogeneity of the Hopewellian art style strongly suggests the existence of a specialized or professional class of craftsmen, rather than the role being one of skill or personal selection. Although the position of the artist in this culture cannot be determined, his presence in the society and the imposing production of art reflect the economic security of the group that permitted the time necessary for the creation and enjoyment of art.

Man and the animal life around him provided the subject matter and basic forms of Hopewellian art. The portrayal of animal life was one of the most interesting expressions of the sculptor's aesthetic impulse, stimulated and maintained in part by ceremonial and ritualistic interests, but also done with an obvious zest and understanding. Concerned with a fauna with which they were extremely familiar, the sculptors were intent on giving the effigies sculptural form and meaning. It is important to note that Hopewellian art seems fully developed, no works having been found that exhibit any preliminary attempts or crude beginnings.

Hopewellian art is basically sculptural, carved from a wide variety of materials, such as clay, stone, mica, bone, and shell. The sculpture consists of carvings in the round, varying degrees of high and low relief, flat two-dimensional forms, incised shapes and cut-out designs.

In this study the art has been divided into two sections, including three-dimensional and two-dimensional sculpture. In the former section, the works conform to styles within several different types of objects; in the latter, they conform to three basic styles — naturalism, semi-naturalism, and conventionalization.

Part I: Three-Dimensional Sculpture

Pipes

Hopewellian sculpture is best known by the great number of finely executed pipes carved from single pieces of pipestone. Although widely distributed throughout the eastern United States, these pipes are predominant at the Ohio Hopewell sites. They can be grouped into five general styles, each having one or more modifications.

Style 1.—Carved from pipestone, these plain bowl platform pipes are stylistically uniform in design, size, shape, and proportion. Symmetrically conceived and perfectly balanced, they are distinguished by the undulating S-shaped profile of the bowl.

Style 2.—Style 2 includes those pipes with the effigy bowls carved in the center of the platform base. Both human and animal forms are usually portrayed facing the smoker. The human forms are restricted to the head, but the animal effigies are represented by the whole form, the upper part of the body, or the head and neck. Frequently the eyes of the animal effigies are inlaid with copper or fresh-water pearls, while there are sometimes traces of red pigment rubbed on the body. These effigies are planned in symmetrical terms, with a complete utilization of sculptural means apparent in the modeling. This ranges from low relief to free-standing rendering of parts. Incision is used to an extraordinary degree with a remarkable mastery of the technique. The greater number and most outstanding examples were obtained from the Ohio mounds.

Style 3.—The third style of Hopewellian effigy pipe is defined by a tubular form with effigy heads depicted at one or both ends. Carved from steatite, these pipes are larger

than the preceding group of pipes, ranging in length from six to ten inches. The planes are more broadly conceived than in the pipes of style 2. Anatomical parts are described by undercutting, while incised details are used to a very limited extent, usually for facial features. Characteristically, attention is focused on the head, with rendering of sensitive facial planes and prominent eyes.

Style 4.—This style is identified by only one specimen found at the Hopewell Mound Group, Ohio. It depicts two carved effigies — a duck seated upon the back of a fish. Although daringly carved in a unique open design, it is stylistically related to the pipes of style 2 in size and proportion.

Style 5.—The last style, consisting of free-standing figures, is the largest such group of examples, ranging in length from seven to over twelve inches. These figures are more rigidly carved than the preceding pipes, with angular planes integrated in a blocklike manner and marked by roughly treated surfaces. They were probably trade pieces, indicated by their close similarity to pipes from the Tennessee-Cumberland region and more southern areas, and by their presence in only one Ohio mound (Seip).

Hollow Effigies

Hollow effigies, carved from several varieties of stone and bone, are identified by a hollow interior carved upward through the base, and by a series of holes perforated into the cavity. These unusual features suggest that the forms were meant to be attached as a decorative addition, or else suspended by a string. They are stylistically related to the effigy pipes of style 2 and generally conform to those dimensions, averaging four to five inches in length. Anatomical parts are indicated by undercutting, eyes are inlaid with pearls or copper, and the vocabulary of incised details repeat those on the pipes. These forms can be divided into three styles.

Style 1.—Style 1 is marked by a distinct naturalism reminiscent of the effigy pipes of style 2. Many of the heads bear the same facial markings as the pipes. The feathers, however, are more rigidly depicted. This is evident by the more deeply pronounced incisions, occasionally forming the parts in overlapping tiers.

Style 2.—This style is based upon one unusual specimen of a duck from the Seip Mound Group, Ohio. It is stylistically modeled with an almost complete geometric reduction of form.

Style 3.—The last style, representing three carvings from the Turner Mound Group, Ohio, is distinctive because of the fantastic, highly imaginative character, imbued with an expressive treatment. There is an attempt to associate the figures with reptilian or serpentine characteristics, as seen in the notched tail and facial features.

Human Figurines

Hopewellian human figurines are comparatively limited in distribution, having been found at only a few sites in eastern United States. The most important finds are the two groups of figurines from the Turner Mound Group, Ohio, and the Knight Mound Group, Illinois. Modeled from a hard terra cotta and clay, the figure groups differ in size, shape, and proportion. They share, however, several minor features in common, which illustrate a general similarity in appearance. These figurines form two distinct styles.

Style 1.—This style is distinguished by the comparatively

intense naturalistic concern of the Turner figures, which are carved from terra cotta. The proportions are generally lifelike, with substantially modeled bodies and as indicated sure understanding of anatomical structure. Comparatively large in size, they range from three to over eight inches in height.

Conceived in a rigid symmetry, they display a complete frontality of form and uniformity of gesture and detail. Parts are carefully shaped, with a clear demarcation of structure. Traditionally they are presented as clothed, with the coverings separately modeled and attached to the figures. Minor bodily features, such as ears and eyebrows, were attached in the same manner. Surviving traces of red and white paint are seen on the surface. Distinctive of the style is a vertical shallow depression representing the spine and stomach structure, correspondingly depicted on the front and back of the figure. The heads are similarly shaped with the forward movement from face to chin accommodated by the upward projection at the rear. Obliquely placed eyes are commonly depicted with the tear ducts tapering to sharply pointed ends.

Style 2.—Homogeneous in style, these five figures from the Knight Mound Group, constitute style 2. They are marked by a disproportionate integration of forms, with the enlarged head slightly less than one-third the length of the body. This concept contrasts with the naturalism of the Turner figures. Characteristically, the surfaces are modified by more extensive decorative painting. The figures are smaller in size, ranging in height from three to four inches. Generally, they exhibit a greater feeling for movement, deviating from the rigid symmetry of the first group of Turner figures. Moreover, two examples depict a woman and child modeled in a unified group. In contrast to the flatness of the body, the head is rounded, with the features clearly defined. As in the Turner figures, the eyes are identically shaped and there is a similar enveloping coiffure. Distinctive of the facial treatment is the pronounced cleft in the upper lip and the general absence of ears. Although compressed in size, the torso retains naturalistic proportions and tapers to abbreviated feet. The legs are modeled close together, bound by the constricting garment.

Human Heads

An important group of specimens are the human heads carved for specific purposes, such as effigy pipes or those broken from the torso of a missing figurine. More widely distributed than the preceding groups of figurines, the greater number of heads have been found in Ohio, with scattered examples from Illinois, Louisiana, and Indiana. Moreover, they are carved from an extensive variety of materials, such as stone, clay, antler, fossilized ivory, and copper. Relatively small in size, they bear no evidence of surface painting; however, several examples are marked with tribal or sacrificial designs. There are both similarities and differences between these heads and the human figurines.

Part II: Two-Dimensional Sculpture

Two-dimensional Hopewellian figurative sculpture consists of both cut-out forms and engravings executed in such materials as copper, mica, shell, bone, and stone. Human, animal, and fish forms are represented, with birds

being the most common. The latter were also frequent in three-dimensional sculpture.

A wide variety of techniques were employed in the realization of the subject matter. These include repoussage, incisions, stamping, and riveting. Perforations drilled through many objects indicate their use as decorative attachments. Occasionally the surfaces are decorated with color limited in range to red and black. There is reason to suspect that a stencil-like form was used, evident by some of the perfectly symmetrical shapes.

Stylistically, these carvings conform to three styles, ranging from a pronounced realism to a complex conventionalization. The provenance of two-dimensional sculpture, except for the engraved pottery vessels, is restricted to the Ohio region. The figurative pottery designs, on the other hand, come primarily from Louisiana, with only several surviving vessels and decorative potsherds from Ohio and Illinois.

Style 1.—In this style the subject is depicted with a convincing naturalism as the record of a clear impression of the animal or figure. Human, mammal, bird, fish, and reptilian forms are represented. The human forms are more generalized than the animal forms, being headless and bearing no indication of sex or surface incisions.

Style 2.—This style is distinguished from the completely naturalistic intent of the preceding group by those forms carved in a combination of naturalistic and conventionalized parts—a naturalistic head with the body stylized into a simple curvilinear shape. This treatment frequently imbues the figure with an expressive rhythmic movement. They are depicted individually, except for several bird forms which are paired. This paired combination, in confrontation, is a readily recognizable motif of Hopewellian art.

Style 3.—Highly conventionalized forms occasionally bordering on the limit of abstraction are distinctive of this style. The effigy is combined with decorative incised elements which sometimes make its identification indistinguishable. The design is composed of curvilinear lines, circles, and ovals, with straight lines rarely employed. These decorative additions are combined either within the form or exterior to it; yet they retain a harmonious unity of the whole. Occasionally the conventionalization progresses to the point where the figure is dismembered and reassembled nearer to the artist's aesthetic desires.

Regional Distribution of Styles

All but a few specimens considered in the dissertation are documented as having been found at mound excavations. It is therefore possible from an analysis of the sculpture to characterize the regional styles in Hopewellian art and to demonstrate important relationships and distinctions between many mound sites.

Ohio.—This analysis reveals the importance of the Tremper and Mound City sites in the carving of effigy pipes (styles 1 and 2), hollow effigy forms being found at the Hopewell Mound Group, Seip, and the Turner Mounds. Particularly unusual is the finding of the only group of human figurines at the Turner mound, existing together with the highly imaginative style of the other carvings from this site. Human heads are more widely distributed, found primarily at the Hopewell Mound Group, Mound City, and Turner. Two-dimensional sculpture, particularly all examples of style 1, came from the Hopewell Mound Group

and Mound City, style 2 from Mound City, Seip and Turner, and style 3 primarily from the Hopewell Mound Group, with a few related examples from the Turner Mound and Mound City.

Illinois.—This region consists of three-dimensional sculpture—the effigy pipes from the Wilson Mound and human figurines from the Knight Mound Group. The only examples of a two-dimensional work is the engraved potsherd from the Snyder Site. There are both similarities and differences between these forms and those found in Ohio, and, to a lesser degree, those found in Louisiana.

Louisiana.—The sculpture is primarily composed of two-dimensional engravings on pottery from the Marksville Site depicting both the single and paired bird motif. Scattered examples of both plain and effigy platform pipes from the Crooks Site recall those from Ohio, but are more crudely handled.

Indiana.—Examples from this region are restricted to the carving of several three-dimensional figures found at the Mann Site. Most striking is the unique animal effigy pipe of a feline. The others consist of a series of human heads bearing an indication of hair striations which has been observed only on heads from Louisiana.

Conclusion

Hopewellian sculpture shows a variety of shapes and formal patterns bound together by such common qualities as roundness, symmetry, and clarity of parts. Varied types of materials were carved in many aspects of sculpture ranging from low relief to free standing figures. This is purely a sculptural art, with minor elements as incisions and occasionally painting subordinated to the total form.

Animals are predominant in the art. Rendered in many ways, these forms demonstrate the considerable expressive possibilities of the figure as depicted by the Hopewellian artist. They are commonly represented either in a strong naturalistic rendition, or are more stylized, retaining, nevertheless, an identifiable head and face.

Distinctive of the art are the two opposing trends of naturalism and conventionalization. In two-dimensional forms conventionalization and occasional distortion is developed to the point that it is considered as a basic style. A vigor and directness of purpose pervade Hopewellian sculpture, concomitant with refinement and preciseness. There is an amazing command of the linear technique, used either to accent parts of carvings in the round or to describe designs on the surfaces of flat materials. The artists had few technical limitations and was able to create a sculptural synthesis based upon his observation of natural form. Stone was the most basic material, apparent in the many general and specific relationships to figures carved from different materials.

Within these generalizations, stylistic variations are discernible in three major regions — Ohio, Illinois, and Louisiana. These variations are within the same tradition, sharing many features in common. Of the three areas, Ohio is the dominant center. This is evident in the greater number of objects found representing all the types and styles of Hopewellian sculpture, as well as in the strong direct expressiveness of the carvings.

Hopewellian sculpture during its life span of approximately 400 years¹ was the most highly developed art in the eastern United States. Related by many common elements, the carvings are readily recognizable and distinct

from the art of other cultural groups. Their art emerged from the context of an advanced culture which possessed some political organization and tribal religion, evident in the great earthwork constructions and established ceremonial procedures. Comparatively, this mature highly developed art style ranks as one of the outstanding aboriginal arts of the Western Hemisphere. The collection and stylistic classification of Hopewellian figurative sculpture prepares the way for future evaluation of cultural attainments among primitive peoples.

Microfilm \$4.45; Xerox \$15.00. 348 pages.

1. Griffin, James. *Archaeology of Eastern United States*. Chicago: University of Chicago Press, 1952, p. 369. Several recent C14 tests place the Hopewellian period from ca. 350-750 A.D.

Abstract published by special arrangement with The Ohio State University.

A PLAN FOR THE IMPROVEMENT OF PUERTO RICO'S HIGHWAY SYSTEM

(L. C. Card No. Mic 59-1962)

Salvador Monserrate Padilla-Escabi, Ph.D.
Cornell University, 1958

The major objective of the thesis is to make a comprehensive study of the highway system of Puerto Rico and a plan for its improvement. Its secondary aim is to test existing techniques of highway planning for use in developing countries, modifying them, or developing new ones when necessary. As Puerto Rico already has a fairly extensive highway system the conclusions derived here are more applicable to countries in intermediate, rather than in the initial, stages of economic development.

Those factors other than traffic that influence transportation such as physical geography, population, political organization and the structure of the economy, must be given special consideration in planning for developing countries. It is also of the utmost importance to carefully examine, plan, and coordinate the over-all transportation system in such a way that the needs for efficient, fast, and economic highway transportation may be appraised properly and provided for. At the same time the transportation effort must be properly integrated with other developmental activities.

The detailed analysis of the highway system begins with a historical account of its development by periods and covers such factors as administration, construction, maintenance, and financing operations. Next the results of the inventory of the existing conditions of rural roads, bridges, and streets are presented. The chapter on the characteristics of highway use describes the methods followed and the results obtained from various traffic surveys of motor vehicle registration, volumes, travel, classification, truck characteristics, speeds, and accidents.

The major factors of highway economics investigated are construction and maintenance costs, road life experiences, and cost and benefit studies for farm to market or local roads. With respect to highway finances the following topics are discussed: over-all governmental fiscal

conditions, highway user taxes and receipts, federal aid, highway expenditures, and highway borrowing practices.

The program for future highway development is based on estimates of future traffic, a highway sufficiency rating and a determination of both urgent and long-range highway needs. For the estimates of future traffic use is made of national income and family income projections to determine future private passenger registration. This in turn is transformed into total registration, total travel, and traffic expansion factors for each road system by the use of historical trends in P.R. as modified by comparisons on the basis of economic conditions with U.S. trends. The sufficiency ratings, although modified to suit the local situation, proved not to be of great help for planning in developing countries where it might be necessary and desirable to promote decentralization or new development even at the cost of not properly servicing existing traffic demands. The analysis of needs shows that in Puerto

Rico there is an urgent need for modernizing the major primary and secondary routes while the need for local roads is not of primary significance.

The proposed plan has an extent of 6550 kilometers exclusive of unimproved roads. It also includes a classification of roads by systems as well as the recommended design standards. Finally a system of priorities of reconstruction and construction is developed so that the expected highway revenues will suffice on the long run to meet the financial demands of developing the rural, as well as the major urban, highway systems and for the maintenance of the whole network.

Of special significance in this thesis are the use of the method of family incomes for registration predictions and the awareness of the need for a very comprehensive approach to highway planning for developing countries. This thesis attempts to be a model of the required planning approach.

Microfilm \$5.35; Xerox \$18.80. 419 pages.

FOOD TECHNOLOGY

THE IDENTIFICATION OF SOME FLAVOR COMPOUNDS FROM STORED INSTANT NONFAT DRY MILK

(L. C. Card No. Mic 59-1888)

Richard Bassette, Ph.D.
University of Maryland, 1958

Supervisor: Dr. Mark Keeney

Successful isolation of some volatile flavorful compounds was accomplished by vacuum distillation of reconstituted milk into alcohol dry ice traps. After characterization of the compounds as carbonyls, it was found to be expedient to entrain the distillates directly into 2,4-dinitrophenylhydrazine reagent traps and thereby avoid the use of alcohol dry ice traps. By this method, 72 kg. of Instant nonfat dry milk powder was reconstituted and distilled over a period of several weeks, to yield sufficient 2,4-dinitrophenylhydrazones for identification.

Separation of the isolated compounds (after extraction from the aqueous phase in petroleum ether) was accomplished on a nitro-methane-hexane Celite column. Chromatographic Threshold Values (T.V.), the volume of solvent required to move the derivative through one gram of Celite, were useful identification clues.

Formaldehyde, acetaldehyde, methylpropanal, 3-methylbutanal, hexanal and nonanal 2,4-dinitrophenylhydrazones were each identified by the agreement of melting points, mixture melting points, T.V. values, and spectra with known compounds. Hexanal and nonanal hydrazones were regenerated to produce the typical odor of the parent carbonyl for further proof of identity. Acetone and 2-butanone derivatives employed the same criteria for identification except: a spectrum was not obtained for acetone and mixture melting point was not taken for 2-butanone. Both *cis* and *trans* 2-furaldehyde as well as 2,3-butanedione 2,4-di-

nitrophenylhydrazones were identified from unique spectra, T.V. values and typical color formation when treated with alcoholic alkali. The 2,3-butanedione derivative produced a typical odor when regenerated. These compounds were considered positively identified.

Heptanal, octanal, decanal, dodecanal, and tetradecanal 2,4-dinitrophenylhydrazones were each identified by their agreement of T.V. values, odor upon regeneration and spectra with known compounds. The evidence for verification of these compounds, although formidable, was not felt to be sufficient for positive identification.

Solvent extraction techniques were attempted, as an initial approach, to isolate off-flavor compounds. It was learned from this study that the flavor character of the milk powder was partitioned into the fat and that a high molecular weight carbonyl fraction formed a 2,4-dinitrophenylhydrazone which could be regenerated to simulate the milk powder odor. It was observed that a milk-like flavor co-distilled with the petroleum ether during extraction of the powder and was tentatively identified as methyl sulfide. The need for methanol treatment of milk powder prior to extractions and 20 hours in the Soxhlet influenced adoption of vacuum distillation techniques.

Attempts were made to obtain a rough estimate of the concentration of carbonyl compounds in reconstituted milk powder. Careful recovery and separation of derivatives from vacuum distillation and subsequent spectrophotometric analysis demonstrated the concentration of carbonyl compounds in reconstituted milk to be: formaldehyde, 0.09; methylpropanal, 0.33; 3-methylbutanal, 0.17; 2-butanone, 0.21; hexanal, 0.38; heptanal, 0.23; octanal, 0.17; nonanal, 0.47; acetaldehyde, 12; acetone, 7.2; dodecanal, 2.3; and 2-furaldehyde, 3.6 micrograms per liter.

Raw milk contained only: formaldehyde, 1.9 micrograms; acetaldehyde, 0.45 micrograms; and acetone, 0.12 milligrams per liter.

Attempts were made to recombine pure carbonyl

compounds in the approximate concentration that they were isolated from stale milk in order to simulate the off-flavor in fresh skim milk. It was found that 5 - 10 times the theoretical (isolated from stale milk) concentration of carbonyl compounds produced an odor and flavor similar to the storage flavor defect.

Fat was found to suppress the odor and flavor of carbonyl compounds (those studied) in milk. It was concluded that the main reason for the typical storage flavor in non-fat dry milk was due to low levels of carbonyl compounds in the near absence of fat.

The nature of compounds isolated and identified, in this study, led to the conclusion that oxidation and browning reactions both occur during storage of nonfat dry milk powder. Microfilm \$2.00; Xerox \$4.80. 91 pages.

STUDIES ON THE ISOLATION AND PREVENTION OF STALE FLAVOR IN DRIED WHOLE MILK

(L. C. Card No. Mic 59-2047)

Wassef Wahba Nawar, Ph.D.
University of Illinois, 1959

Early in the storage life of dried whole milk, a stale flavor develops which reduces consumer acceptance of the product. Efforts to prevent the development of this "off flavor" has always been handicapped by a lack of fundamental knowledge of the responsible chemical compounds and the mechanism of their formation. Since earlier work has shown that the stale-flavor components of dried whole milk are concentrated in the fat, can be partially separated from stale butteroil by steam-distillation or Girard's T-extraction, this study is concerned with their further fractionation.

The effect of concentration of Girard's T-reagent (Trimethylacetylhydrazideammonium chloride) upon the extractability of the flavor components from the butteroil of stale dried whole milk was investigated. More complete extraction was achieved at the lower concentrations of this reagent, a behavior similar to that of some aldehydes. By means of a combination of Girard's T-extraction and CCl_4 -vapor distillation of stale butteroil, two different stale-flavor fractions could be obtained. One of these is non-volatile, can be extracted with Girard's T-reagent and reacts with 2,4-dinitrophenylhydrazine; the other is volatile and does not react with either Girard's T-reagent or 2,4-dinitrophenylhydrazine. The Girard's T-extract was separated by paper chromatography into a stationary and a mobile component. The later appeared to contain the majority of the stale-flavor compounds. The R_f value of the mobile fraction was apparently equal to that of the reaction product of n-heptaldehyde, suggesting similar partition coefficients in the systems used. A cellulose column was designed to secure more efficient separation of larger quantities of these materials. The Girard's T-extract was further fractionated with 2,4-dinitrophenylhydrazine, and paper chromatography of the hydrazones. At least three spots not present in the controls were obtained and compared with those of known carbonyls. The odors of the released carbonyls were described.

While the CCl_4 -vapor distillate of stale butteroil con-

tains carbonyl compounds, these do not seem to contribute to the stale flavor. Therefore, treatment of the CCl_4 -vapor distillate with 2,4-dinitrophenylhydrazine and the recovery of the distillate by a subsequent CCl_4 -vapor distillation provided a practical method in the purification of the volatile stale-flavor components. By means of chromatography, five 2,4-dinitrophenylhydrazones of the carbonyls in the CCl_4 -vapor distillate were obtained and their R_f values were compared with and appeared to be different from those of the Girard's T-extract. The odors of the released carbonyl compounds were also described.

Further fractionation of the volatile non-carbonyl stale-flavor compounds was attempted by means of gas-liquid partition chromatography. At least nine components could be resolved over the temperature range of $60^\circ - 190^\circ\text{C}$. This technique appears to be a promising tool in the isolation and identification of these compounds.

Two storage studies, designed to destroy the stale-flavor components with alkali as suggested by earlier work, have shown that alkaline treatment of the condensed milk before drying does not appear to be a practical method in delaying or preventing the development of stale flavor in dried whole milk.

Microfilm \$2.00; Xerox \$5.40. 107 pages.

FACTORS AFFECTING BROWNING OF POTATO CHIPS—NEW TYPES OF MODEL SYSTEMS FOR STUDIES OF BROWNING

(L. C. Card No. Mic 59-1823)

Vitolds Racenis, Ph.D.
Rutgers University, 1959

Major Professor: Dr. R. E. Morse

The major problem in potato chipping is control of desirable color. Production of colored pigments or browning is the result of a reaction between reducing sugars and nitrogenous components of the potato tissue. In this investigation the role of total solids in browning of potato chips was studied in model systems.

Two basic types of model systems were developed; one using filter paper as the solid matrix, the other using starch to represent the solids content. Glucose and glycine were the sources of browning reactants. Color intensity produced by the browning reaction varied with the solids content of the model system. Final color was proportional to the weight or total surface area of the solid matrix. Doubling solids content had the same effect as halving the concentrations of browning reactants. For comparison with potato chips, concentrations of browning reactants in model systems must be expressed in mg per gram of solids instead of solution concentrations. The concentration in solution constantly changes as water is evaporated in the chipping process, thus the important factor in model system studies is the absolute amount of browning reactants in the total mass of solid matrix. Using this concept the maximum theoretical color intensities obtainable by certain fractions of browning precursors found in potatoes were studied. Results obtained by filter paper model systems depended on the method of preparation of the model system. Advantage of the starch model system was that other substances

could be incorporated and studied in the model system. Pectins showed browning in model systems. Colloidal substances decreased the rate of water removal from the model systems. As a result, browning reactants are kept in more dilute solution and at lower temperature for a longer time. Slightly lighter color intensities were obtained. Substitution of varied amounts of other substances for starch, such as silicic acid and cellulose, did not change color intensity. Model systems containing amylopectin absorbed greater quantities of fat than model systems containing amylose.

Previous studies had indicated that potato tissue of poor chipping quality contains smaller starch granules than potato tissue of good chipping quality. Starch granule size, however, had practically no effect on browning in model systems.

The rate of starch synthesis was studied by reacting glucose-1-phosphate with potato juice from potatoes of good and poor chipping quality. Twenty-one different varieties were tested. A variation in the ability of potato juice to synthesize starch was found. Three different basic types of behavior were observed - very poor synthetic activity, steady gradual synthesis, and rapid initial synthesis with subsequent degradation of the initially synthesized starch. Synthesis could be induced in the potato varieties showing poor synthetic activity by a heat treatment of tubers at $52 \pm 1^\circ \text{C}$ for 3.5 hours. The degradation of synthesized starch could be corrected by carrying out synthesis in 3×10^{-5} molar mercuric chloride solution.

Good or poor chipping quality could not be associated with any one of the three different types of synthetic activity of potato juice.

Microfilm \$2.00; Xerox \$6.60. 136 pages.

A STUDY OF A SPECTROPHOTOMETRIC METHOD FOR THE FLAVOR EVALUATION OF INSECTICIDE TREATED VEGETABLES

(L. C. Card No. Mic 59-1825)

Daniel Rosenfield, Ph.D.
Rutgers University, 1959

Major Professor: Dr. Walter A. MacLinn

The use of organic insecticides for controlling plant pests has increased six hundred per cent in the past two decades. Many of these insecticides are responsible for flavor alteration in vegetables. Continued development of organic insecticides coupled with their expanded use has magnified the limitations of flavor panels for evaluating insecticide treated foods. Therefore, this investigation was designed to develop an objective method of flavor evaluation to obtain more accurate and reproducible results than possible with a flavor panel.

From a literature review it was concluded that flavor effects of insecticide treatments can be manifested in the lipid fraction of vegetables and might be characterized by absorption spectrophotometry.

Test vegetables were Chantenay carrots, Carmel cross corn, and Purple Top White Globe turnips. Carrots and turnips were grown in the summer of 1956 on soils which had been treated with chlorinated insecticides in the sum-

mers of 1952 through 1954. Carrots, turnips, and corn were grown in the summer of 1957 on soils with no previous insecticide treatment. These soils were treated with chlorinated insecticides one week before planting.

In 1956, the vegetables were frozen after harvesting; in 1957, the vegetables were canned. Within six months after processing, samples were evaluated by a trained flavor panel. Flavor data were analyzed by an analysis of variance to detect significant differences between insecticide treated and untreated samples.

First step in objectively evaluating samples was lyophilization in order to concentrate them to make available a sufficient quantity of lipids in small size samples. Condensates from the lyophilization step were collected. Lyophilized vegetables were extracted with ethyl ether, ethyl alcohol (95 per cent), carbon disulfide and carbon tetrachloride. Condensates were extracted with carbon disulfide. Examinations of extracts in the visible, ultra-violet and near-infrared regions were made with a Beckman DK-2 recording spectrophotometer. Special techniques were used to prepare carbon disulfide extracts for infrared region examinations which were made with a Perkin-Elmer IR-21 recording spectrophotometer. Spectra of extracts were compared to see if samples with flavor differences had spectral differences.

Flavor differences in insecticide treated carrots, corn, and turnips were associated with differences in infrared absorption spectra of carbon disulfide extracts of condensates. In a majority of samples, carbon disulfide extracts of condensates from treated samples had infrared absorption bands which were more intense than bands from extracts of condensates of untreated samples. Carbon disulfide extracts of lyophilized vegetables with flavor differences did not show infrared spectral differences.

With the exception of ethyl alcohol extracts of untreated and BHC treated carrots and turnips, flavor differences in insecticide treated vegetables could not be characterized by visible, ultra-violet and near-infrared region spectrophotometry. At 280 millimicrons, ethyl alcohol extracts of BHC samples had absorption bands which were more intense in many cases than bands from alcohol extracts of untreated samples.

A study of the results shows that vegetable volatiles are involved in flavor differences caused by insecticides.

Microfilm \$2.00; Xerox \$4.40. 84 pages.

A STUDY OF SODIUM CHLORIDE DIFFUSION INTO PORK MUSCLE TISSUE

(L. C. Card No. Mic 59-1834)

Hugo Eryk Wistreich, Ph.D.
Rutgers University, 1959

Major Professor: Roy E. Morse

Diffusion of sodium chloride from solution into pork muscle tissue was investigated. The amount of sodium chloride diffused into muscle per 1 cm^2 of contact area with solution was called "accumulation value." The accumulation value was found to increase with temperature in a non-linear way. There is a resistance to sodium chloride diffusion into pork muscles, which is not specific to sodium ions. Changes in solution pH and added proteolytic

enzymes did not affect the accumulation value. Added sodium chloride appeared to be evenly distributed throughout the muscle tissue. The accumulation value varied directly with solution concentration. Solution volume increase caused increase of accumulation value. The logarithm of accumulation value varied directly with the logarithm of time. The combined effects of time, solution concentration and solution volume on accumulation value at 3°C are expressed by the equation:

$$\log A = 0.42 \log t + \log c + \log (1.7V + 40.2) - 2.58$$

where A - is NaCl accumulation value in mg/cm².

t - is time in hours.

c - is solution concentration in g/l.

V - is solution volume in ml per cm² of contact area.

Microfilm \$2.00; Xerox \$4.40. 83 pages.

GEOGRAPHY

PROBLEMS ASSOCIATED WITH PREDICTING LAND USE IN LOW LATITUDE HUMID REGIONS: A CASE STUDY OF THE SAN SEBASTIAN-RINCON AREA, PUERTO RICO

(L. C. Card No. Mic 59-2198)

Dale Elliott Courtney, Ph.D.
University of Washington, 1959

Chairman: Donald Hudson

This study investigates land use planning in a low latitude humid region. Specifically, it (1) analyzes many of the problems that are characteristic of planning in such locations, (2) outlines a land use planning method for an underdeveloped area that may be followed in similar regions, and (3) presents land use prediction as a means of analyzing the effects that changes, planned or unplanned, may have on local areas in general, and on the local population in particular.

The method of predicting land use required (1) inventory of resources, (2) analysis of land use, (3) investigation of factors that influence land use changes, (4) establishment of land units based on the physical characteristics of the land, (5) classification of land units according to suitability and productive capacity for the crop or crops under consideration, (6) measurement of the land units in each class, (7) projection of land use patterns from the area where the crop is grown to the sectors where it is not grown, and (8) prediction of land use based on assumptions derived from the study. Following the method enabled the author to gain an understanding of the problems of land planning in low latitude humid regions.

The San Sebastian-Rincon Area of Puerto Rico exhibits many of the characteristics of other underdeveloped areas in low latitude humid regions. The physiography and soils are complex and marked contrasts in patterns and intensity of land use are evident. Many of the people have a low standard of living and little formal education. Although more information is available than for many underdeveloped areas, much research is needed. Sugar cane, the local cash crop, is subject to market controls and fluctuations originating outside of the area. Many other similarities, too numerous to list here, are brought out in the study.

The area and its dominant crop, sugar cane, were selected for purposes of demonstrating the problems associated with the prediction of land use. The analysis of the

problems provided the framework upon which the prediction of land use for sugar cane was evolved. A final product of the analysis was the prediction of three levels of land use for sugar cane in the study area. Leading problems that influenced the analysis were: the attitudes of the farm population, farming practices, increased use of machinery, markets and quotas, subsidies, competition with other producing areas, and insular government policies.

The study indicates that the high cost of production and increasing competition with other crops and other areas will necessitate an increase in per acre yields for cane. The acreage planted will probably remain near current levels or decrease moderately. The increase in yield will be attained in part by improved farming practices, increased use of fertilizers better adapted to meet local soil needs, and improvement of varieties of seed cane. The use of machinery will increase on gently sloping and level land. Land not suited for machinery will be placed at a competitive disadvantage, and the tendency for sugar cane to be concentrated on soils of high quality will be strengthened. These changes will cause some inconvenience and hardship among the local population. Although wages will increase with mechanization, the number of jobs in agriculture will decrease. The added employment in service and trade will probably not be sufficient to offset the decrease in demand for farm workers. The standard of living for the area will be difficult to raise or, in fact, to maintain in the face of an increase of population. The rate of population increase will create problems that demand continuing attention of planners.

Microfilm \$3.10; Xerox \$10.60. 238 pages.

NUMERICAL AND DISTRIBUTIONAL ASPECTS OF MARYLAND POPULATION, 1631-1840

(L. C. Card No. Mic 59-1914)

Arthur Eli Karinen, Ph.D.
University of Maryland, 1958

Supervisor: Professor Kenneth J. Bertrand

This study is an attempt to trace the numerical and distributional development of Maryland's population from the time of first white settlement in 1631 to 1840.

Numerically it grew from a few score to a total of 470,000, and distributionally it changed from small groups on the Bay to a population spread over the entire state. These changes are illustrated by a series of dot maps.

With few exceptions data, prior to the first federal census of 1790, pertain to segments of the population, such as taxable persons, militia, or number of houses. It is difficult to determine what proportion each of these represents of total population. Most numerous are data for taxable persons. The ratio varied because the Assembly made changes in the definition of a taxable, and because of changes in composition of population. In the early years taxable persons made up 50 percent of the population, but by 1700 they comprised only 33 percent.

The Indians, though numbering only 5,200 at the time of first white settlement, did influence settlement. From them the whites acquired knowledge of corn and tobacco cultivation and learned how to utilize the fish resources. For years tobacco was the basic economic resource. Indian trails were frequently used by whites and developed into wagon roads.

From 1631 to about 1670 the rate of population increase was over 100 percent per decade, but from 1670 to 1730 it dropped to between 30 and 45 percent. What factors caused this slowing down is impossible to say. Land was still available along shores of Chesapeake Bay and interstream areas were as yet virtually untouched. Growth of population in the counties shows considerable variation. A number of the larger declines were caused by the formation of new counties. Increases in growth rates often resulted from a decision by the proprietary to grant, for a time, lands in some particular area or areas.

During the 1631-1730 period settlement spread from several rather than a single center, progressing along the shores of the bay and navigable estuaries. By 1730 all habitable water front sites were taken, and only the interior areas of the Coastal Plain counties remained unoccupied. The Piedmont and Western Maryland were essentially unsettled. Land holdings ranged from manors containing thousands of acres to small holdings of a hundred acres or less. Since no great need for towns existed they developed slowly.

From 1730 to 1790 population increase was 20 percent or more per decade, while during the 1790-1840 period it declined 10 percent or less. The slowing of growth was largely a result of emigration to the west. In some counties declines were quite marked, indicative of considerable population movement.

During the 1730-1840 period settlement spread into the Piedmont and Western Maryland and into the interstream areas of the Coastal Plain. The penetration into the Piedmont was in the form of a pincers movement. From Pennsylvania on the north Germans, with a grain-livestock economy, moved into the Monocacy Valley, while the English from the Coastal Plain with their tobacco-slave labor economy moved up the Potomac Valley.

The development of land transportation routes played an important role in the settlement of the Piedmont and Western Maryland. Settlements frequently grew around the accommodations built for travelers. Since individual farmers could no longer deal directly with the ship captain as the tobacco farmer on the Coastal Plain had, the need for trade centers grew. The remarkable growth of Baltimore Town was due to its good road connections with the interior. Microfilm \$4.25; Xerox \$14.20. 330 pages.

THE DISTANCE RELATIONS AND SOME
OTHER CHARACTERISTICS OF CROPLAND
AREAS IN PENNSYLVANIA: AN EXPERIMENT
IN METHODOLOGY FOR EMPIRICALLY
ANALYZING, REGIONALIZING AND DESCRIBING
COMPLEXLY-DISTRIBUTED AREAL PHENOMENA

(L. C. Card No. Mic 59-2245)

James Parker Latham, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Lester E. Klimm

Phenomena which occupy unevenly-sized, irregularly-shaped, variously-oriented, and complexly-extended areas present a challenge. It is often necessary to map such dispersants, and make smaller scale generalizations which communicate an understanding of the distribution. To avoid subjective generalization, methods based on empirical-quantitative measurement are needed. This dissertation develops and applies two such systems to "Cropland Areas in Pennsylvania," which were mapped from interpretations of the 1:20,000 aerial photographs.

Utilizing a line representing a certain distance (e.g., one mile), this complex distribution is organized according to its distance relations. The "D-line," by agglomerating and bounding all cropland within one mile of other cropland, divides the state into two categories: (1) Contains all cropland and small non-cropland areas composed of surface points within one-half mile of cropland; and (2) Contains only non-cropland, and hence is a "pure" core. When the method is applied to non-cropland, a reversed two-fold classification yields cropland cores. As cores are located on an uninterrupted "all-directions" spread of surface type, they express a significant pattern characteristic.

By combining the two analyses, the surface is divided into three categories: (1) contains only cropland; (2) contains only non-cropland; and (3) contains cropland and non-cropland points within one-half mile of both surface types.

The first boundaries, which agglomerated cropland, also provide a basis for delimiting major cropland and non-cropland regions. Major cropland regions are subdivided into minor regions by analyzing the distance relations of the cores, hence providing a multi-region organization of the distribution.

Within these regions, areal phenomena are so complexly distributed it is often impossible to isolate the dispersants into units, and hence difficult to determine and describe the size, shape, and orientation of the occurrences. Some characteristics of cropland and non-cropland intra-region distribution are sampled by evenly-spaced parallel traverses, and the intercepts with each dispersant are organized into an array or frequency-like table of distance (length) classes. Median and quartile values of the uninterrupted distances (intercepts) are determined for each dispersant. They indicate aspects of the "average" journey crossing the region in the directions sampled, and make it feasible to describe the journey in terms of: (1) proportion of passage on each surface type; and (2) percent of passages across a surface type that will fall within given minimum and maximum distance classes.

The parallel traverses are rotated to sample six

azimuths thirty degrees apart, and the comparison of medians and quartiles for these azimuths indicate the orientation of the dispersants. These values, expressing distance and orientation characteristics, are summarized in a graphic symbol named "The Orientation Rose." From the data secured from the rotated parallel traverses it is also possible to estimate for each region: (1) area; and (2) proportion of area occupied by each dispersant.

The conclusions are of two classes. First, the D-line method of analysis regionalizes an areal dispersant of extreme complexity according to its distance relations and derives objectively located and bounded regions. Regionalizing on several levels or scales establishes a hierarchy

of regions ranked by the distance relations of the dispersant or of the dispersant's cores. A D-line analysis of one dispersant automatically analyzes some aspects of the alternate surface by isolating its larger occurrences as cores. Second, within regions the measurement of uninterrupted surface distances (intercepts) along rotated parallel traverses provides quantitative data for verbally, statistically, and graphically describing passages over dispersant surfaces when moving through particular regions. Variations due to orientation are revealed. The total area of a region and its proportion occupied by a dispersant can be estimated.

Microfilm \$3.80; Xerox \$12.80. 293 pages.

GEOLOGY

**THE STRATIGRAPHY AND MINERALOGY OF
THE METAMORPHOSED BIWABIK IRON
FORMATION, EASTERN MESABI
DISTRICT, MINNESOTA**

(L. C. Card No. Mic 59-2379)

James Ronald Novotny Gundersen, Ph.D.
University of Minnesota, 1958

The members of the Biwabik iron formation, as they occur in the Eastern Mesabi district, have been divided into 22 submembers. The correlation between these submembers and the stratigraphic units of earlier workers is presented. The generalized petrographic features and the distribution of the mineral assemblages of each submember are discussed in detail in a chapter on stratigraphy.

Chemical analyses and the diagnostic optical properties of some of the dominant minerals of the formation are presented in a chapter containing a brief discussion of all the minerals of the district.

A final chapter discusses the metamorphism of the iron formation. Some of the metamorphic mineral assemblages occurring in the system Fe-Si-H-O and, in particular, the ferrous silicates lying in the plane $\text{FeO-SiO}_2\text{-H}_2\text{O}$ that are in equilibrium with magnetite are briefly reviewed. The retrograde nature of the paragenesis of the ferrous silicates has been determined by studying many specimens from a given stratigraphic horizon throughout the area. The mineral paragenesis observed cannot be readily produced by progressive metamorphism of the 'primary silicates' found on the Main Mesabi range. The formation of the metamorphic minerals and the explanation of the observed paragenesis are discussed with the aid of a $\text{FeO-SiO}_2\text{-H}_2\text{O-(MgO)}$ diagram. The recrystallization of most of the present mineral assemblages is related to the metamorphic effects accompanying the emplacement of the Duluth gabbro. The origin of some of the calcium- and magnesium-rich ferrous silicates is interpreted to be metasomatic and related to the many calcium-rich, granitic pegmatites that cut the iron formation.

Microfilm \$2.60; Xerox \$9.00. 198 pages.

**THE OXIDATION OF SULFIDE ORE BODIES WITH
SPECIAL REFERENCE TO SELF-POTENTIALS**

(L. C. Card No. Mic 59-2369)

Motoaki Sato, Ph.D.
University of Minnesota, 1959

Electrochemical studies of environmental factors and mechanisms of oxidation of sulfide minerals were made. The origin of self-potentials associated with sulfide ore bodies are discussed based on the results of these studies.

The probable ranges of oxidation potential and pH values for the weathering environment and those for the depth environment were studied through field measurements of Eh and pH values of natural waters in mining districts, experimental oxidation of iron and manganese solutions by air, and theoretical considerations of chemical and mineralogical factors involved in natural systems. The oxidation potential for the weathering environment is found to be largely controlled by the potential of the $\text{H}_2\text{O}_2\text{-O}_2$ couple. Hydrogen peroxide forms during the reduction of oxygen in aqueous solution and is catalytically decomposed back to oxygen and water by various elements, some of which are common in natural systems. The catalytic decomposition of hydrogen peroxide establishes a metastable equilibrium between the hydrogen peroxide and oxygen, resulting in the control of the oxidation potential of the weathering environment by the above couple. The oxidation potential for depth environment is probably controlled by oxidation-reduction reactions involving iron minerals, iron being the most common among the elements which occur in more than one state of oxidation in rocks. Limitations may be imposed on the pH values for these environments by the dissociation of ferric hydroxide at the acidic side, and by the hydrolysis equilibria of carbonate and silicate minerals at the basic side.

An understanding of the electrode characteristics of sulfide minerals makes it possible to identify their oxidation or reduction mechanisms through single electrode potential measurements in solutions containing appropriate oxidation or reduction product ions. The electrode potential of a sulfide mineral is controlled by the first step of

the oxidation mechanism for the sulfide in an oxidizing solution, and by that of the reduction mechanism in a reducing solution. When in equilibrium with a solution, the electrode potential characteristic of a sulfide mineral becomes that of a mixed electrode potential type, in which the sulfide maintains equilibrium with the solution in both oxidation and reduction reactions, the net effect being simply a dissociation equilibrium. Sulfides of copper, lead, silver, iron, and zinc were studied. The results indicate that oxidation (or reduction) of a sulfide mineral is a step-wise process, in which metal (or sulfur) moves into solution step by step. The path of the step-wise oxidation is generally different from that of the step-wise reduction for a metal-sulfur system. The potential of the first-step electrode reaction for oxidation (or reduction) of a sulfide mineral is called the oxidation (or reduction) "reaction potential" of the sulfide. The relationships of reaction potentials with pH are graphically represented in "reaction Eh-pH diagrams". It is shown that such reaction Eh-pH diagrams provide pertinent information for the discussion of oxidation of sulfide ore bodies.

Self-potential anomalies are not limited to sulfide ore bodies, but are common to many chemically inactive electro-conductive bodies that lie partly in the zone of weathering and partly in the depth zone. The common source of energy required to maintain electric currents that produce self-potentials is found to be indirect oxidation of substances at depths by atmospheric oxygen, which is accomplished by transfer of electrons from the depth zone to the weathering zone through electro-conduction within such conductive bodies. The maximum expected values of the self-potential anomalies over various menomineralic sulfide ore bodies are discussed from the stand-point of oxidation potential and pH values for weathering and depth environments and oxidation reaction potentials for sulfide minerals. Microfilm \$4.30; Xerox \$14.40. 335 pages.

GEOLOGY OF PART OF THE NORTHERN WALLOWA MOUNTAINS, OREGON

(L. C. Card No. Mic 59-2210)

Harry Wynn Smedes, Ph.D.
University of Washington, 1959

Chairman: Peter Misch

The area described in this report is about 230 square miles of the central northern part of the Wallowa Mountains of northeastern Oregon. The highest part of the range lies in the map area, where the maximum relief is over one mile and the highest peaks are at elevations of about 10,000 feet.

Rocks of the area include Permian volcanic and sedimentary rocks, Mesozoic plutonic rocks of the Wallowa batholith, Tertiary volcanic rocks, and unconsolidated deposits of Quaternary age. The aggregate thickness of Permian and Triassic stratified rocks in the area is at least 12,000 feet, and may be over 18,000 feet.

The oldest rocks in the area are altered and metamorphosed volcanic and sedimentary rocks of the Permian Clover Creek greenstone. Pyroclastic and albitized lava rocks of basaltic and andesitic composition prevail in the

lower part of the greenstone and apparently give way upward to conglomerate and other sedimentary rocks largely derived from volcanic sources, with subordinate lava and pyroclastic rocks and quartz latite ignimbrite. Intrusive bodies of gabbro and diorite occur only in these Permian rocks and may have been contemporaneous with part of the greenstone.

Upper Triassic rocks directly overlie the greenstone and are divided into three formations. The lower formation is the Lower Sedimentary series, and contains metamorphosed impure shale, sandstone, conglomerate, limestone, and tuff. The middle formation is the Martin Bridge formation which consists of metamorphosed limestone with local thin beds of shale and tuff. The upper formation is called the Hurwal formation and contains metamorphosed impure shale, siltstone, impure limestone, and local sandstone. Some of the clastic rocks are tuffaceous and of graywacke aspect.

The earliest tectonic event recorded in the map area is that of the production of an east-northeasterly trending highly sheared strike-slip fault zone in Permian and Triassic rocks of the Middle Mountain area. Following this deformation, the Triassic rocks were sheared off from the underlying Permian rocks along an extensive décollement thrust plane and moved north-northwestward across the map area relative to their substratum. Five or more separate thrust sheets were developed above the basal décollement, and piled up above each other as they moved north-northwestward. Intensely compressed overturned and recumbent folds are integral parts of the piled up thrust sheets. A north-northwesterly trending regional syncline, perhaps created by buckling of the thrust belt, was superimposed upon the thrust structure in the northwestern part of the area. This deformation took place during the middle of the Mesozoic.

The Wallowa batholith was emplaced into and to the south of the regional syncline, and as a northeast trending prong that separates the northwest from the southeast structures. The batholith is a large mass of varied composition, structure, and texture, the bulk of which is quartz diorite and granodiorite. Thermal metamorphism induced by the batholith resulted in broad zones of hornfels, granulite, and marble. Local sheet-like zones of schist and schistose amphibolite probably represent recrystallized mylonite along thrust faults. Replacement processes resulted in zones of granitized rock along the contact. Contacts are gradational in many places, and country rock structures locally extend into the batholith. The Sawtooth stock, east of the Lostine River, appears to have been emplaced largely by static replacement processes. The main batholith mass was largely emplaced by forceful intrusion, but was in part emplaced by static replacement processes along the margins. The regional syncline was accentuated and deformed by the force of intrusion; old and newly-formed structures were sharply deflected around stocks, which had a buttressing effect; and new folds developed, the abundance and magnitude of which increase toward the batholith contacts. Weak foliation indicates an arch of northeast trend in the northeast prong of the batholith.

Post-batholith events consisted of uplift and erosion, with the development of a mature erosion surface. Flows of Columbia River basalt covered the surface and were subsequently arched along a north-south axis trending through the middle of the map area. The flows were fed

by a multitude of basalt and diabase dikes whose striking north-south suggests that they occupy tensional fractures related to the same stresses that subsequently produced the arch of the lavas. Arching apparently culminated in about 5000 feet of uplift along a northwest trending fault zone - the Wallowa Fault zone. This fault zone marks the northern precipitous front of the range.

Strong maxima of joint trends indicate a north-south

and an east-west set probably related to the arch of the lava flows, and a northeasterly trending set that is probably related to the foliation arch in the batholith.

Radial drainage developed upon the lava plateau and was disrupted locally by stream capture due to faulting. Glaciation steepened the old valleys and created new small-scale features through the action of plucking in strongly jointed rocks. Microfilm \$3.50; Xerox \$11.80. 270 pages.

HEALTH SCIENCES

HEALTH SCIENCES, NURSING

THE SELECTION OF CHEMICAL PRINCIPLES AND CONCEPTS ESSENTIAL IN NURSING

(L. C. Card No. Mic 59-2391)

Virginia Grace Braley, Ph.D.
University of Pittsburgh, 1959

I. INTRODUCTION

The purpose of this study is to develop a method for identifying and selecting those chemical principles and concepts which the professional nurse needs to know in order to administer comprehensive nursing care.

The investigation is limited to the identification and selection of chemical principles and concepts applied to the physical aspects of direct care for patients in hospitals of the University of Pittsburgh Medical Center. The primary sources of data are student records and patient records.

II. THE METHOD

There are seven steps in the investigation: (1) selecting disease conditions on the basis of frequency and importance, (2) selecting patient records by sampling, (3) preparing the summary of the typical clinical picture of each of the disease conditions, (4) analyzing that portion of the patient records concerned with diagnostic tests, medications, and treatments, (5) identifying the knowledge needed by nurses to understand, to assist with, or to perform procedures associated with these tests, medications, and treatments, (6) identifying the chemical principles and concepts believed to be essential in understanding this knowledge, and (7) compiling the final list of chemical principles and concepts which are essential for the administration of comprehensive nursing care.

The disease conditions analyzed were alcoholism, amputations, asthma, burns, carcinoma of breast, diabetes mellitus, epilepsy, glomerulonephritis, leukemia, peptic ulcer, rheumatic heart disease, and rheumatoid arthritis.

The patient records were selected by the Medical Record Librarians, in a random sampling, from the clinical areas where the conditions occurred most frequently between March, 1950, and June, 1955.

A summary of the typical clinical picture served as a check on the investigator for completeness and as a method for identifying additional facts relating to the disease conditions.

The chairmen of the five clinical nursing departments and the Department of Public Nursing checked the work sheets for completeness and accuracy.

The broad chemical principles and concepts believed to be essential for understanding the data on the work sheets were identified by inference. Authoritative sources of information were consulted to verify the investigator's judgment. The 95 principles and concepts thus identified were organized into ten categories: General Chemical Reactions, Water, Solutions, Carbohydrates, Proteins, Enzymes, Oxygen, Metabolism, Blood, and Radioactivity and X-ray.

Four judges with experience in teaching in schools of nursing or in the School of Medicine were asked to delete items, to add items, or to correct items as they appeared on the work sheets.

The frequency of these principles and concepts in relation to the disease conditions and the elements of comprehensive nursing care were studied. The final selection of principles and concepts was made by the chairmen of the clinical departments responsible for selecting the learning experiences which would utilize this data. These judges were asked to rate the items as essential, desirable, or unnecessary. By majority opinion of these judges, 84 items were rated as essential and 10 items were rated as desirable. There was divided opinion on one item as to whether it was essential or desirable. On the basis of this analysis, all 95 items were retained.

III. ILLUSTRATION OF USE OF DATA

The following illustrations of the use of the data are included: (1) teaching applied chemistry to nurses, (2) applying chemical principles and concepts in clinical courses, and (3) applying chemical principles and concepts in the solution of nursing problems arising daily.

IV. CONTRIBUTIONS

The utilization of patient records as a primary source of data for identifying and selecting chemical principles and concepts essential in the generic professional program in nursing was demonstrated. The study increased the validity of the master list as a tool to be used in the selection of clinical learning experiences for students in nursing.

The method demonstrated should be useful in identifying the principles and concepts in other science areas. Other conditions of high frequency should be studied. Tools to appraise the competence of the students in the utilization of the principles and concepts should be developed.

Microfilm \$3.60; Xerox \$12.20. 279 pages.

HEALTH SCIENCES, PHARMACY

A PHARMACEUTICAL STUDY OF
A GUM FROM RAIN LILY
(*COOPERIA PEDUNCULATA*)

(L. C. Card No. Mic 59-2203)

Wallace Louis Guess, Ph.D.
University of Washington, 1959

Chairman: L. Wait Rising

A heretofore undescribed plant principle was extracted from the bulbs of *Cooperia pedunculata*; the principle was purified and characterized as a new gum with several physical properties similar to those of other pharmaceutical gums.

A preliminary chemical investigation of the gum from *C. pedunculata* (commonly known as Rain Lily) revealed that the gum gave reactions common to many of the known gums, namely, sensitivity to alcohol precipitation, precipitation by lead subacetate, and ability to reduce Fehling's solution after hydrolysis by acid. It was also found that the gum was a polysaccharide and the principal sugar was identified as mannose by chromatographic procedures as well as by determination of the melting point of its phenylhydrazone. The infrared spectrum of a dried film of the gum was grossly similar to the spectra of most other gums commonly used in pharmacy, yet specific enough that a rapid identification of the gum would be possible.

Rain Lily gum exhibited rheological properties usually associated with natural colloids. The gum developed high viscosities with small increases in concentration. This viscosity was comparable to that developed by tragacanth. The viscosity characteristics of Rain Lily gum were determined when mixed with many chemicals used in pharmaceutical products. The effect of aging, temperature, and pH on the viscosity of Rain Lily gum was also investigated.

The efficiency of Rain Lily gum as a primary emulsifier for liquid petrolatum, cod liver oil and kerosene was investigated. It was found that Rain Lily gum would function as an effective emulsifying agent in low concentration for liquid petrolatum and cod liver oil but was not effective in producing a stable emulsion of kerosene. The stability of these emulsions was studied by determining mean globule diameter and the rate of growth of globules on standing. It was found that the method of mean globule determination had merit as an indication of the internal stability of an emulsion. On the basis of the diameter of the globules and viscosity produced in emulsions with Rain Lily gum as the emulsifier, the gum would be better classified as an auxiliary emulsifier rather than a primary emulsifier.

The use of Rain Lily gum in several types of pharmaceutical formulations was investigated. As a suspending agent, the gum was found to be essentially as effective as tragacanth and sodium carboxymethylcellulose. Rain Lily gum was found to be incompatible with bismuth subgallate, bismuth subcarbonate and sodium borate.

Although there is no scientific definition of a jelly as concerns its consistency, Rain Lily gum produced jelly-like preparations having a consistency more suitable than tragacanth, which is used in Ephedrine Sulfate Jelly, N. F. It was found that the consistency of Rain Lily gum jellies could be controlled not only by varying gum concentrations,

but also by changing the amounts of sodium borate (used as a gel-inducing agent) and the humectant propylene glycol.

The hydrophile-lipophile balance (HLB) of Rain Lily gum resulted in an HLB value of 11.9. Several emulsion formulas were prepared with Rain Lily gum on the basis of its experimental HLB value, and all formulas produced acceptable preparations. Thus the accuracy of the HLB value and the suitability of this predictive system for application to gums in emulsions was confirmed.

It was concluded from this study that Rain Lily gum merited further study as a potentially useful pharmaceutical gum. Microfilm \$2.00; Xerox \$5.80. 118 pages.

THE PERMEABILITY OF RED CORPUSCLES
TO SOME MONOHYDRIC AND
POLYHYDRIC ALCOHOLS

(L. C. Card No. Mic 59-1744)

Paul Zanowski, Ph.D.
The University of Florida, 1959

Although the hemolytic method has been used extensively in permeability studies, until recently little application of the method has been made to the study and preparation of isotonic solutions. When solutions are calculated to be isotonic with blood according to measurements of colligative properties, they may not be isotonic to erythrocyte membranes. Data derived from the hemolytic method are more reliable for isotonic calculations.

Employing the hemolytic method, a series of monohydric and polyhydric alcohols was investigated. The degree of hemolysis of rabbit and human erythrocytes in solutions of varying concentration of these compounds was determined quantitatively. When possible, these data were used to calculate van't Hoff *i* values.

Results indicated that the monohydric and polyhydric alcohols studied which had a molecular weight less than that of erythritol caused complete hemolysis in concentrations calculated to be isosmotic. Certain concentrations of the monohydric alcohols caused hemolysis even in the presence of 0.6 per cent (0.1M) sodium chloride. This was true of the normal monohydric alcohols investigated as well as their isomers.

The low molecular weight diols and triol investigated did not cause hemolysis in the presence of 0.6 per cent sodium chloride. The polyhydric alcohols of higher molecular weight prevented hemolysis. For erythritol *i* values of less than 1.00 were found. Such *i* values might indicate a degree of permeability of the erythrocytes by these compounds. Mannitol, sorbitol, and inositol showed *i* values of approximately 1.30 to 1.40. Values of *i* greater than 1.00 might be ascribed to a loss of electrolytes from within the erythrocytes. The presence of 0.2 per cent (0.03M) sodium chloride did not alter this abnormal exosmosis.

From this investigation, it appeared that the phenomena occurring at the erythrocyte membrane in the case of alcohols might be influenced by molecular weight and the number of hydroxyl groups present. The ratio of hydroxyl groups present to the number of carbon atoms in the molecule might be important.

Microfilm \$3.15; Xerox \$10.80. 242 pages.

HISTORY

HISTORY, ARCHAEOLOGY

THE "HISPANORVM" COINS. PROBLEMS IN SICILIAN NUMISMATICS AND HISTORY.

(L. C. Card No. Mic 58-7839)

Kenan T. Erim, Ph.D.
Princeton University, 1958

The excavations sponsored by Princeton University at Serra Orlando, in Central Sicily have produced a large quantity of finds in the course of the first two campaigns. By far the most abundant discoveries were coins. This dissertation deals with one particular series of bronze coins that occurred frequently in the excavation of Serra Orlando and had never been very carefully studied. The coins are characterized by a Latin legend on their reverse reading "HISPANORVM", and the two most common types combine an Athena head or an unidentified male head on their obverses with a galloping horseman on their reverses. Hitherto this coinage had been attributed to Sextus Pompey who made himself master of Sicily from 43 to 36 B.C. Indeed, to the best of our knowledge no specimen of the "HISPANORVM" coins was ever found outside of Sicily. The general interpretation of the legend on the reverse assumed the presence of Spanish elements in Pompey's armies. There can be no question that the largest single group of the HISPANORVM coins was found during the excavations of Serra Orlando, and the majority of these coins was found in such a context that it soon became evident that the reexamination of the chronological position of the coins was imperative.

Generally speaking, the material unearthed alongside the HISPANORVM coins, whether pottery, terra-cottas, amphora-handles or other coins, was definitely in favour of a second century B.C. date. The same holds true for the architectural context within which all the finds occurred. At least five other types or denominations of the HISPANORVM coins were discovered in the course of the excavations: some of them were not known before, while others existed as single specimens in certain collections. Close examination of the whole series reveals unquestionable, typological ties with the coinages of Sicily (particularly the Mamertine issues) and Southern Italy.

A historical interpretation of the coins within the frame of the second century B.C. can be satisfactorily achieved; indeed, according to Livy (XXVI, 21, 17), a group of Spanish mercenaries was settled by the Romans in the central Sicilian town of Morgantina, or Murgantia, at the close of the Second Punic War (211 B.C.). This settlement served mainly as a punishment for Morgantina which had twice revolted against Rome and as a reward for the assistance extended to Marcellus by the Spaniards during the siege of Syracuse in 212 B.C. It is very likely that the immediate descendants of the Iberian soldiers issued the HISPANORVM coins in Morgantina sometime after the middle of the second century B.C. The silence that surrounds Sicily and Morgantina herself in the first half of the second century

is an indication of peace and slow recovery from the Punic Wars, which could well culminate in the issuance of coinage by the Spaniards of Morgantina. A large number of Sicilian communities are known for their bronze coinage under Roman rule, even if from an artistic point of view the coins in question are not always very refined.

In the second half of the second century B.C. the whole of Sicily and Morgantina became involved in the Servile Wars. Morgantina's role in these conflicts is uncertain, but the town was certainly besieged by the slaves in the course of the Second Servile War (104-101 B.C.) according to Diodorus (XXXVI, 4, 5,). The HISPANORVM coins may have been struck partly before the First Servile War (139-131 B.C.) and partly after.

As far as Morgantina herself is concerned, her history prior to the settlement of the Hispani goes back to prehistoric times and to the fifth century B.C. Her location is much open to discussion and controversy: Licodia and Monte Jùdica, among others, have been suggested so far. Serra Orlando is actually an even better candidate than any of these: it fits all the topographical requirements that can be extracted from Diodorus Siculus who happened to be a native of neighbouring Agyrum (present Agira). Diodorus' testimony should be given the importance that it deserves. Above all, however, the great majority of the HISPANORVM coins, as well as some earlier issues of Morgantina herself found in Serra Orlando make the identification quite plausible. It remains to wait for definitive, additional evidence from the excavations to demonstrate the full accuracy of this suggestion.

Microfilm \$4.40; Xerox \$14.80. 342 pages.

HISTORY, MEDIEVAL

THE ANGLO-FLEMISH CONFLICT (1270-1274) AND ITS EFFECTS

(L. C. Card No. Mic 59-2208)

Gordon Stuart Peek, Ph.D.
University of Washington, 1959

Chairman: Henry S. Lucas

Around 1100 A.D. the wool trade established a basis for Anglo-Flemish economic cooperation: the English supplied the wool while the Flemings manufactured it into cloth. This arrangement flourished for 150 years -- and was accompanied by a corresponding growth of Anglo-Flemish political interests -- only to be seriously interrupted for the first time in 1270 by an economic war between the two countries.

The first chapters of this monograph are devoted to an examination of the circumstances which produced that

conflict and its conclusion. The attempt is then made to indicate the major developments in England and the Low Countries attributable in some degree to the Anglo-Flemish quarrel which have been generally overlooked in earlier investigation of the subject.

From the information available, it appears that before 1270 the merchants from Flanders, who handled by far the largest share of the English wool trade, had organized themselves into the Hanse of London to facilitate and maintain their control of that commerce. By 1265, however, other merchants, including Englishmen, Brabançons, Italians, and Hollanders, were evincing a desire to participate more actively in that lucrative business, but Flemish domination prevented them from doing so.

When, in the autumn of 1270, the English broke with the Flemings over a relatively insignificant feudal matter -- a money fief -- they sought to force the county into submission by attempting to stop any wool from reaching the cloth manufacturers. This plan was not immediately successful, but by July 1274 it had presumably proved effective for at that time the Flemings capitulated.

Between September 1270 and July 1274, merchants of England (who were then in the process of organizing themselves into the Staple), Brabant, Italy, and elsewhere, filled the vacancy created in the wool trade by the forced exclusion of the Flemings. Consequently, after 1274 the Flemings were unable to regain the supremacy they earlier enjoyed. The significant role of the Anglo-Flemish conflict therefore, in replacing the influence of the Hanse of London with that of the Staple and other non-Flemish merchants, should not be minimized.

Other changes also resulted in part from the economic realignment created by the Anglo-Flemish war: Anglo-Brabançon diplomatic ties were greatly strengthened; the Italians assumed an ascendant position in English commerce and finance; and political and commercial relations between England and Holland, which were very weak before 1270, had improved so markedly by 1280 that a marriage between the ruling houses was in the offing.

Finally, the Anglo-Flemish struggle of 1270 appears to have been somewhat responsible for the revision of English customs which occurred in 1275 and which served as a basis for the customs system for many centuries. Because the war had forced up the price of wool, the merchants more willingly accepted a tax which seemed low in comparison. Moreover, there is considerable probability that information provided by certain statistics, compiled in the endeavor to regulate the wool trade during the war which rather accurately reflect the volume of that commerce, may have contributed to the formulation of this tariff.

An unfortunate dearth of Flemish documents created a considerable problem in the preparation of this thesis. Much reliance has been placed, therefore, upon English sources, particularly the Patent Rolls, Close Rolls, and Fine Rolls. These contain a wealth of information about economic and political activity in the thirteenth century; the analysis and calendaring of them by previous scholars augments their usefulness. For this reason a special effort has been made to eliminate any pro-English bias which might prevail as a result of such dependence upon the available source materials.

Microfilm \$4.40; Xerox \$14.80. 344 pages.

HISTORY, MODERN

UNITED STATES DEFAULT OF WORLD LEADERSHIP: ITS MAJOR TREATY NEGOTIATIONS OF THE NINETEEN-TWENTIES

(L. C. Card No. Mic 59-1781)

Harold Cooper, Ph.D.

The University of Nebraska, 1959

Adviser: James L. Sellers

The United States defaulted its position in World Affairs in 1920. As World War I drew to a close Woodrow Wilson exercised his responsibility in the nation's external relations to such an extent that the United States was respected for the first time as a leading World Power. But there was an anti-Wilson remnant within the Republican party which dated all the way back to the Presidential election of 1916. As soon as Wilson announced his plan for a "Peace Without Victory" the anti-Wilson forces began their destructive work. They failed to understand the meaning of a "Peace Without Victory". They could not visualize all the political and philosophical implications of such a goal beyond the election of 1920. Consequently these anti-Wilsonians fought the President at every turn in the last two years of his administration. They defeated the Treaty of Versailles and the League of Nations in the Senate on two occasions. With the help of Woodrow Wilson they made the League an issue in the election of 1920. As soon as the election was over, Harding proclaimed the death of the League.

The echo of the inaugural address had scarcely died away before Harding became aware of the need to score a diplomatic triumph in order to perpetuate his administration in power. However, he dared not move in the direction of the League because that was tainted with Wilsonianism. He turned first to naval limitation. But the League had already begun a disarmament program and the best the United States could do was supplement the League program. The United States was the only major power at the Washington Conference not a member of the League. When the Harding administration proposed "an association of nations" to replace the League, it was spurned by the other members of the Conference. From this point the United States representatives had to be content to participate in the councils of the League as official, semiofficial or unofficial observers. And while the European Powers urged the participation of the United States in the League at its inception, they came to feel a sense of security without the United States by the mid-twenties.

Harding's successors continued to play the naval limitation theme throughout the decade. The Washington Conference proved the vote-getting ability of naval disarmament and it was still an advantageous thing for politicians to talk about in nineteen-thirty. Coolidge tried to promote naval disarmament in two ways. First, there was the "abortive" Geneva Conference which ended in a dismal failure. After Geneva Kellogg and Coolidge had more apparent success in promoting the movement to outlaw war which culminated in the Pact of Paris. Like the Washington Conference this success was only superficial.

In 1929, when Hoover was inaugurated, the only ratio agreement among the major naval powers was still the Washington agreement on capital ships. Hoover hoped to extend the ratio to other categories. His administration

promoted a new naval disarmament conference. But Hoover's success was little better than that of his predecessors. The London Conference of 1930 became a rearmament conference.

The basic source for this study has been in the correspondence of the State Department. A study of this material has led to the following conclusion. While the Senate was an impediment for the Executive Department in the decade of the nineteen-twenties, this is not the whole story. The Presidents of this decade failed to carry out their constitutional responsibilities in foreign affairs. They preferred to withdraw from the rest of the world for political reasons. The only leadership they supplied in this period tended to undermine the framework of collective security established after World War I.

Microfilm \$6.10; Xerox \$21.20. 480 pages.

**A HISTORY OF LUTHERANISM IN THE
ANDHRA DESA (THE TELUGU TERRITORY
OF INDIA) 1842-1920**

(L. C. Card No. Mic 59-1944)

Martin Luther Dolbeer, Jr., Th.D.
The Hartford Seminary Foundation, 1957

In this thesis the author has attempted to portray the various movements which lie back of the growth of one of the largest Churches in India today.

Chapter I introduces us to the background of the 19th Century missionary movement in the Lutheran Church, both in Germany and the United States. Early missionary movements in Pietism awaken the missionary spirit in England, which in turn revitalizes the Church in Germany and brings to life the Missionary Societies. Spreading to America this same spirit leads to the establishment of Foreign Missionary Societies in the Lutheran Synods.

Chapter II, after a brief portrayal of the land, history and early Christian efforts in the Andhra Desa, develops the historical beginnings of four Lutheran Missions in the Telugu territory by the American Churches and three German Societies -- North German, Hermannsburg and Breklum. These extend over a forty-year period, from Heyer in Guntur (1842), Valett in Rajahmundry (1845), Mylius in Sulerpet (1865), to Pohl and Bothmann in Salur (1882).

Chapter III covers this same initial period and deals with the reaction between the missionary and the government, civil leaders, religious leaders and the common people. Also discussed are the early policies based upon the primary purpose of the Lutheran Missions: establishment of the Church through preaching, religious education, development of native literature, training of native leadership and gathering of congregations. The failure to train native pastors in the early years and to establish village congregations rather than station-centered congregations retards the growth of the Missions. The attitude of the missionary toward caste and social customs indicates that serious social changes will be necessary for those who embrace Christianity.

The middle period of our historical review, in Chapter IV, has been titled "The Difficult Years." It stretches from 1860 for the early Missions to 1914 for the later Missions. The work is seriously hampered, almost stopped in some

cases, by the financial difficulties of the American and German Churches and the War periods. In India the social pressure and persecution evident whenever a native takes the step to become a Christian place roadblocks in the progress of the Missions. Just as difficult is the effort to bring the Christians, primarily outcastes, out of the degradation of their former lives, past the tragedies of famine and disease, to the point of establishing the church community. The Missions find that cooperation between them is necessary in these difficult years.

Chapter V, covering the years through 1920, gives a sweeping survey of a period of tremendous growth and expansion. As the financial situation improves in the Home countries and interest increases in the work of missions, the Lutheran Missions are able to extend to new areas, undertake large building programs, and increase both missionary and native staff to meet arising opportunities. Long years of labor now result in large movements of outcaste people into the Church. This creates serious problems in adequate training, moral and spiritual growth, pastoral care and in developing self-supporting and self-governing congregations. Upper castes also are being attracted, by the example of the outcaste. To meet this rapid development, the Missions find it necessary to initiate or expand their work in the fields of education, literature, medicine, institutions of mercy and industrial schools. Government assistance and working with other mission bodies aid in the effort.

The thesis closes with a critical backward glance over the whole period, and a brief look beyond 1920 when the Lutheran Missions, through mergers and closer cooperation, devolve from Missions to the Lutheran Church in the Andhra Desa. Microfilm \$6.15; Xerox \$21.40. 481 pages.

NEW YORK'S MEN'S CLOTHING TRADE, 1800 TO 1861

(L. C. Card No. Mic 59-2231)

Egal Feldman, Ph.D.
University of Pennsylvania, 1959

Supervisor: Thomas C. Cochran

The purpose of this study is to determine and describe the factors that gave rise to the New York men's clothing trade, in its formative period, 1800-1861.

Sources largely relied upon included newspaper advertisements, reports of chambers of commerce, census reports, accounts of travelers, and city directories.

The solution to the problem of why the New York men's clothing trade grew with such rapidity in 1800-1861 came by answering a series of guiding questions. What attractions did the New York clothing market have for the country buyer? Were any attempts made by New York clothiers to extend retail and wholesale outlets to the South?, to the West?, and if so, what problems did they encounter? What role did the New York City local retail market play in the expansion of the clothing trade? How important was New York City as a center of fashions? What role did immigration play in the New York clothing trade? To what degree did technological innovation figure in the manufacture of clothing? How important was the sewing machine? What status did the clothier have in society?

Answers to the above questions point to the conclusion that the New York clothing trade expanded and reached a point of national preeminence by 1861 largely because it was in a better position than any other urban area in the country to supply a growing demand for clothing.

Geographically and commercially it was so located that all streams of traffic converged at its doorstep. Raw material, as well as an abundant labor force, was assured to it from the Old World, while unindustrialized and underdeveloped areas of the New World -- the South and West -- looked to it for a supply of ready made clothing.

Its merchants took every advantage of the City's commercial supremacy, and intensified its attractiveness in every way. Every effort was made to lure the country buyer to the metropolis. Abundant advertising, and attractive credit policy, well regulated auctions, large displays, vigorous promotions of fashions of ready made, as well as custom made garments, as well as an inconceivable variety of merchandise in the rapidly multiplying clothing houses, forced merchants to turn to New York rather than to other wholesale centers.

Every advantage was taken of the great need for clothing in the unindustrialized areas of the United States. New Orleans, Charleston, Savannah, St. Louis, Chicago, San Francisco, and other cities, housed representatives, as well as retail outlets of New York firms. No American city seemed beyond the reach of the New York clothing merchant, and to each its invoices were shipped with a clock-like regularity.

The popularity, as well as the prosperity, of the New York clothing trade was further enhanced by its retail trade, which fed upon an urban population growing with greater rapidity than any other city in the United States. Every convenience was offered to the buyer at retail, just as it was to the buyer at wholesale. Frequently advertised prices and fashions of both custom and ready made garments, huge placards, numerous signs, a pushing salesmanship, as well as other traffic-stopping devices, were utilized early, if at times crudely, by the New York retailers.

The productive machinery of the New York clothier met every test which an increasing national demand placed upon it. Custom tailor shops, as well as wholesale plants were systematically managed; and mechanization took every advantage of the technological advances of the age.

By 1861 the New York clothing trade had emerged as one of the outstanding factors in the economic life of New York City. It had supplied fortunes to a few, and employment to thousands. Women as well as men partook of its advantages. The few crises which befell it -- one in 1837-1842, another in 1857-1858, and the last in 1860-1861 -- if viewed in long terms, did not hamper its growth. With the coming of Civil War New York clothing dealers were well equipped to alter their production of ready made clothing for men to uniforms for Union troops.

Microfilm \$4.00; Xerox \$13.40. 309 pages.

ALABAMA IN THE FORMATION OF THE CONFEDERACY

(L. C. Card No. Mic 59-1727)

Melvin Durward Long, Jr., Ph.D.
The University of Florida, 1959

This dissertation recreates by the study of affairs in one state, Alabama, the spirit and attitudes of the South in 1860-1861. It is a study of Alabama's part in forming the Southern Confederacy and an attempt to discover the extent to which people in Alabama endorsed secession and the organization of a Southern government. A by-product of such an inquiry is the investigation of local politics in Alabama during the winter of 1860-1861, and the problem of analyzing the vote in the presidential election of 1860 and the election of delegates to the Alabama Convention of 1861.

The basic sources for the subject were contemporary Alabama newspapers, the manuscript returns for the Census of 1860, and letters and memoirs. Official documents, secondary monographs, biographies, collected source materials, and general interpretations of the period and subject were sampled generously.

In tracing the affairs in Alabama significant conclusions were reached. The Alabama Platform, which by 1860 rejected any presidential candidate who was not in favor of the protection of slavery in the territories, was the anvil on which the Charleston Democratic convention was split. The determined Douglas supporters and the adamant Alabama delegates share the responsibility for the failure of that convention.

The presidential election in Alabama was fought out by the Bell, Breckinridge, and Douglas factions in the traditional party manner with all three claiming to be the party of Union. Many secessionists were to be found in each faction, with the greatest number in the Breckinridge camp, but secession was not visualized by the voter as the dominant issue. Neither economics, party loyalty, nor sectionalism adequately explains the presidential vote of 1860. The economic interest groups in large measure did not vote as a bloc. The Bell support came from the old Whig areas. Breckinridge support was general, coming from all groups and sections. Douglas received his greatest support in former Democratic areas where there was a trading town and an appreciable number of market garden farmers, foreigners, and/or manufacturing laborers.

As soon as it was ascertained that Lincoln would be elected when the electoral college met, Alabama's Governor Andrew Barry Moore appointed commissioners to consult with the other slaveholding states. The governor also called a convention. In the campaign for delegates the separate and immediate secessionists outnumbered those who advised Southern cooperation. The election clearly indicated sectionistic tendencies with the cooperationists concentrated in north Alabama counties and the immediate secessionists in the other parts of the state. Both groups, however, were determined not to submit to Lincoln and Republicanism.

By January 7, the ideas of secession and a confederacy were growing in favor with most Alabamians. The work of the commissioners assured the convention that Alabama had many allies who would join her in secession and others who would come to her rescue in case of coercion. Alabama withdrew on January 11, 1861. In spite of a few portents and minor disaffection in pockets of the state, there

was almost complete unanimity in support of the state's secession. Factors which produced this climate of opinion were: a decade of propaganda, the uncompromising attitudes and defiant speeches of Republican leaders; the Southerner's mental image of Lincoln; the apparent success and peacefulness of secession; the priority of loyalty to one's state; and the real fears of economic loss and racial amalgamation. Because of these factors Alabama's part in 1860-1861 in the formation of the Confederacy was not surpassed by any other Southern state.

Microfilm \$2.95; Xerox \$10.20. 226 pages.

THE PRIVY COUNCIL AND TRADE AND INDUSTRY 1588-1603

(L. C. Card No. Mic 59-1932)

James Byron Patrick, Ph.D.
The University of Wisconsin, 1957

Supervisor: Professor William L. Sachse

The Privy Council of Elizabeth was a highly influential and powerful group of capable men. The range of its duties extended from the details of economic life to major problems of war and peace. Its work was primarily administrative or executive, but to some extent it was legislative and judicial. Because it had no paid agents to enforce its orders, it had to depend on local officials. Usually these men were loyal to the Council, but they might ignore conciliar commands when such crossed their private interests or in their opinion were not for the good of the community. Although the Councilors were landed gentlemen, not personally much interested in industry or commerce, they gave excellent direction to these activities, usually considering the best interests of the whole realm in their decisions.

Industry, slowly evolving from the guild to the domestic system, was an important link in the Council's policy for strengthening England's economy. In fostering fishing the Lords sought to increase the number of ships and mariners available for defense, and in the brewing industry it aimed at conservation of grain for food. In mining and related enterprises the Lords worked to make England independent of continental materials. They were eminently successful in munitions, which involved iron, copper, calamine, and coal. The industry of cloth-making was considered essential, and the Council fostered it through importing skilled foreign workers, protecting the manufacturers, working to provide abundant raw materials and enforcing high standards of workmanship.

Internal trade was not big business, and the Council's only problem in that field appears to have been an equitable distribution of grain. Because the years following the Armada were years of depression and dearth, the Lords gave much attention to this matter. They worked to regulate the activities of corn broggers, regraters, forestallers, and engrossers, and to provide a constant supply of grain in markets at prices all could afford. They required licenses for buying and transporting large quantities of grain, urged the practice of Christian charity, and brought in foreign grain to supplement the local supplies. Although

these measures were not completely successful, there was no real famine or serious food riots during the period.

External trade was largely in the hands of trading companies. The Council favored them, helped them maintain their monopoly against interlopers, assisted in obtaining foreign staples and favorable trade agreements, negotiated and revoked company charters, and arbitrated company disputes. It also issued general shipping embargoes, assisted merchants in difficulty, and even attempted to control the shipping of other nations. The Council sought to protect English shipping through police action in home waters, commanding that all merchant ships be armed and travel together, and even requiring armed escort in especially dangerous waters.

The Council handled all international trade negotiations. It eliminated the competition of the Hanseatic League. It endeavored to persuade the Low Countries and France to stop food shipments to Spain, and to accept English cloth on condition that its quality be improved. In the Low Countries it interceded for the Merchant Adventurers, obtaining favorable treaties for their trade in that country, and in France it sought justice for its merchants who had been "spoiled" by Frenchmen.

Both industrial and commercial monopolies existed under Elizabeth I. The Council was entrusted with the responsibility of seeing that the patentee's rights were protected, and that the patentee did not interfere with the best interests of the people. The Lords could see the abuses that arose, but their loyalty to the Queen forced them to uphold the system. Keeping a balance in an unstable economic situation was the constant problem of these capable men.

Microfilm \$3.70; Xerox \$12.60. 287 pages.

IMPEACHMENTS AND THE PARLIAMENTARY OPPOSITION IN ENGLAND 1621-1641

(L. C. Card No. Mic 59-1415)

Danila Cole Spielman, Ph.D.
The University of Wisconsin, 1959

Supervisor: Professor William L. Sachse

In 1621 the house of commons invented the modern process of impeachment. That procedure, at first simply a convenient way for the commons to tackle an offender whom they wished punished by parliament, soon became a means of bringing down great ministers of the crown.

This account of the great impeachments of the pre-Civil War years was constructed from the notes of debates in the two houses of parliament taken for official records and for private use. The purely legal aspects of the subject have been touched upon very little, for these impeachments are primarily acts of the parliamentary opposition, which by the end of 1641 had grown powerful enough to attempt to impose its will on the king.

The parliamentary opposition was not a party in the modern sense, in that it did not oppose a party in control of either house of a legislature. The opposition led the house of commons and in the house of lords opposed a loosely-knit group of courtiers who led only by weight of

numbers. Consequently the tiny opposition in the lords had influence out of proportion to its voting strength.

The leaders in the commons eventually found themselves opposed to the men whom they deemed responsible for policy which threatened the right of the subject, the safety of the realm, the power of parliament, and the privileges which made that power secure. They did not express that form of opposition in impeachment before 1626. Francis Bacon was impeached as a bribe-taker, and Lord Treasurer Middlesex suffered primarily because Buckingham engineered an impeachment to destroy this rival for the king's favor.

The commons impeached Buckingham in 1626 and Strafford in 1640 because they believed these two men had attempted to destroy the accord between the king and his loyal parliament. Because the opposition was unable to admit that the alliance between king and parliament fostered by the Tudors had broken down, they were forced to adopt the view they took toward Buckingham and Strafford.

This enmity toward evil counsellors expressed itself in terms of law, not politics. Though they were actually able politicians, the commons leaders thought as lawyers. To them Buckingham and Strafford, like Bacon and Middlesex, were criminals, and they treated them accordingly.

This combination of faith in an alliance long since dead and a legal approach to political problems proved unmanageable. When the commons tried to force the lords to find Strafford guilty of treason, the accord between the houses broke down and the commons resorted to an attainder which they pushed through with the help of a mob. Though there were impeachments aplenty in the 1640's, the Strafford trial represents the breakdown of the purely legal impeachment. After 1640 impeachment became a political weapon, not a legal device to bring councillors to justice. Microfilm \$3.25; Xerox \$11.20. 251 pages.

A HISTORY OF THE CHILEAN BOUNDARIES

(L. C. Card No. Mic 59-2058)

Robert Dean Talbott, Ph.D.
University of Illinois, 1959

The first boundaries of Chile were established for Pedro de Valdivia, the conqueror, in his grant extending from 27° to 42° S. latitude and one hundred leagues inland from the Pacific Ocean. After Valdivia's death, Chile was extended southward to include the Straits of Magellan. However, two areas were transferred from the jurisdiction of Chile during the colonial period. In 1563, Tucumán, east of the Andes, was included in the territory of the Audiencia of Los Charcos. Two centuries later this area and Cuyo, the other transmontane province of Chile, became part of the Viceroyalty of Río de la Plata.

At the close of the colonial period, Chile's boundaries extended from the Desert of Atacama to the Straits and from the Pacific Ocean to the Andes. There was no boundary line since the border areas were uninhabited or sparsely populated by Indians.

After Chile obtained her independence, she faced the problem of maintaining her freedom and of organizing a government. She became involved in civil war, centering her attention on internal affairs until the early 1830's.

During this period of disorganization, European states became interested in the Straits. England, France, and Sweden sent expeditions to the area to obtain scientific information. The French government considered colonization of the Straits as a port of call between France and her new South Pacific possessions. Although England did not consider colonization, both Chile and Argentina feared this possibility. At the time England and Argentina were disputing over the Falkland Islands.

When the former Spanish colonies in South America declared independence, they took those boundaries which they possessed as colonies. This principle, known as the *uti possidetis* of 1810, became part of South American international law, and was recognized as a principle of frontier demarcation. The Spanish kings had usually named natural features; mountains, rivers, or deserts; as the boundaries of the divisions of their empire. The border areas became areas of conflict when the independent states expanded into them. This process began in the 1830's in Chile.

The discovery of nitrates in the Desert of Atacama began the boundary dispute which involved Chile in the War of the Pacific in 1879 against Bolivia and Peru. In this dispute, extending over a period of almost one hundred years, Chile expanded her border almost five hundred miles northward. The Tacna-Arica controversy over sovereignty of the former southern provinces of Peru disturbed the relations between Chile and Peru until the United States' offer of arbitration in 1922. A direct settlement resulting from the arbitration attempt gave Chile Tacna.

Shortly after the discovery of nitrates, Chile colonized the Straits of Magellan. In her southern expansion, Chile opened a boundary question with Argentina which began in 1843 and is not completely settled at the present time. This dispute eventually included the entire eastern boundary between Chile and Argentina.

The Boundary Treaty of 1881 divided Tierra del Fuego and established a demarcation principle for the remaining boundary. Disagreement on the interpretation of this principle almost resulted in war. Arbitration peacefully ended the question. The northern section, the Puna de Atacama, was demarcated in 1899 with the arbitration of William Buchanan, United States minister in Argentina. The center section had been submitted to the arbitration of Queen Victoria in the preceding year.

In 1902, the Beagle Channel Islands lying south of Tierra del Fuego were claimed by both nations. Because of their small importance, this controversy, continuing to the present time, has not disturbed friendly relations between the two countries.

Microfilm \$2.55; Xerox \$8.80. 194 pages.

JAMES R. GARFIELD: THE CAREER OF A ROOSEVELTIAN PROGRESSIVE. 1895-1916.

(L. C. Card No. Mic 58-5576)

Jack M. Thompson, Ph.D.
University of South Carolina, 1958

The public career of James R. Garfield, second son of President James A. Garfield, as a Rooseveltian Progressive was prefaced by a conservative Republican background and a brief political service as state senator (1896-98) in

Ohio. Garfield hoped to emulate his father's career, but failing to win further political favor in Ohio, he accepted an appointment to the Civil Service Commission in 1902.

After a brief period as a civil service adviser, Garfield was appointed the first Commissioner of Corporations in the Department of Commerce and Labor. During his four years as Commissioner (1903-07), he pursued, with Roosevelt's advice and approval, a policy that had as its ultimate objective a rapport between the federal government and the business community. Convinced of the efficacy of large scale production, Garfield and Roosevelt opposed return to the classical concept of competition and contemplated a type of business morality and activity which would be realized through government paternalism and supervision. As Commissioner, Garfield directed investigations of the beef and petroleum industries. A report on the former exonerated the major meat packers, who had been under public fire, but a report on the oil industry exposed Standard Oil's unethical practices in the field of petroleum transportation.

Impressed by Garfield's administrative ability, Roosevelt promoted him to the cabinet in 1907. As Secretary of the Interior, he overhauled the department's archaic business methods and became an enthusiastic devotee of Roosevelt's conservation program. William Howard Taft did not retain Garfield who returned to the practice of law in Cleveland, Ohio. His successor, Richard A. Ballinger, reversed a number of his policies and provoked the famous Ballinger-Pinchot controversy. Garfield remained aloof from the public dispute over conservation, but Taft's defense of Ballinger convinced him that the President was determined to reverse Roosevelt's governmental program. Garfield's failure to gain the Republican nomination for governor of Ohio in 1910 furthered his distrust of the Republican party and its leadership. He believed the nation's salvation and that of the Republican party depended on Roosevelt's return to the presidency in 1912. When the party failed to nominate the Rough Rider, he immediately joined the Progressive bolt.

The 1912 election convinced Garfield that the new Progressive party would replace the Republicans, but after the catastrophic 1914 elections, in which he was swamped as a Progressive candidate for governor, he realized that he had been mistaken. This defeat, opposition to Woodrow Wilson's domestic and foreign policies, and Roosevelt's defection from the Progressive cause convinced Garfield that he should support Charles Evans Hughes in 1916. After the 1916 election he announced his reconversion to orthodox Republicanism. It was a proper decision for Garfield was essentially a conservative Republican.

Microfilm \$3.75; Xerox \$12.80. 292 pages.

THOMAS PRINCE: PURITAN POLEMICIST

(L. C. Card No. Mic 59-2212)

John Edward Van de Wetering, Ph.D.
University of Washington, 1959

Chairman: Max Savelle

Thomas Prince, co-pastor of the Old South Church in Boston, spent forty years working as a polemicist for the

reestablishment of traditional Puritan leadership and influence in New England society. Puritan leadership had been weakened with the advent of secular political control in Massachusetts under the royal charter of 1691, and the growing secular spirit in the community, and it became more and more difficult for the Puritans to insist on the singular character of New England as a land in covenant with God and subject to His special dispensations.

Prince devoted his career to the reassertion of Puritan influence in New England society by pietistic appeals for conversion, and periodic insistence on the singular character of the New England covenant society. Prince's sermons were a deep lament for the degenerate state of New England society and an awful warning of the wrath of God in punishment. Indirectly his sermons became appeals for the reassertion of Puritan leadership in the community through an emotional allegiance of the individual to the church. Prince hoped that such an emotional attachment could establish a strong informal Puritan power to replace the loss of formal political leadership. He used both history and science to strengthen his appeal. The ordered universe of Newton could illustrate the wondrous power of God and the compatibility of an ordered Puritan state with the nature of God. Prince's Chronological History was intended to show the special nature of New England as a land chosen by God for the Puritan elect and to indicate the great virtue of the founding fathers.

Prince's approach brought him into conflict with another Puritan faction. These opponents to the emotional, pietistic appeal of Prince pursued a more "catholic spirit" and placed less emphasis on the character of New England as a covenant society. In some cases they stressed the strain of rationalism in Puritan theology. The resulting factional strife weakened the Puritan position even more.

Prince reached the height of his career in 1740 with the advent of the Great Awakening. His emotional, pietistic appeal needed little alteration to be in tune with the revival. The Awakening and the few years of Prince's career that followed the revival suggest his dedication to the re-establishment of Puritan influence in New England society, and his lack of concern for intellectual consistency in his struggle for renewed influence. He did not seem concerned by the challenge the revival offered to the exclusive character of New England Puritanism. Yet, when the revival had ended he worked alternately on his Chronological History that was intended to prove the uniqueness of New England as a land chosen by God, and on a series of patriotic sermons intended to give the Mother Country and New England a common interest in the eyes of God. By implication he placed old England and New England under a single covenant.

Prince lived for more than ten years after the Great Awakening, but the revival marked his last chance to make his pietism a telling social force. The Awakening had seemed like the long awaited answer to his cries for renewed religious interest, and when the movement began to wane Prince damaged his position of leadership in the Puritan community by his continued support.

Microfilm \$5.30; Xerox \$18.80. 416 pages.

SOME FACTORS AFFECTING THE LABORATORY PERFORMANCE OF CERTAIN ELASTIC FABRICS UNDER VARIOUS LAUNDERING TREATMENTS

(L. C. Card No. Mic 59-2348)

Mildred Lecy Bell, Ph.D.
University of Minnesota, 1959

Adviser: Suzanne Davison

This study was undertaken because homemakers need and desire a better understanding of laundering procedures for elastic garments which will best maintain the physical properties of the original fabric. In general, today's homemaker has little time and suitable space for the hand wash, dripdry laundering procedures currently recommended for elastic garments.

Part I. A preliminary investigation of the effect of various laundering treatments on the physical properties of a rayon power net elastic fabric with rayon-covered rubber yarns (rayon-rayon) was made to determine the treatment combinations which would best retain the properties of the original fabric.

The variables studied were: temperature (100°, 140° F.), detergents (built and unbuilt soaps and syndets), bleaches (chlorine and sodium perborate), and drying methods (rack and tumble). Distilled water was used in the Launder-Ometer for a ten-minute washing period and for three rinses.

Elastic recovery, initial set, permanent set, dimensional stability, and color changes were determined on samples withdrawn at specified laundry intervals (0, 1, 3, 5, 10, 20, and 30). Analysis of variance was used to interpret the complete factorial design.

The findings showed that the most effective treatment combination was 100 F. temperature, no bleach, built soap, and rack drying.

Part II. The treatment combination chosen from the Launder-Ometer study was adapted for use under home laundry conditions.

Four elastic power net fabrics were washed in an agitator type automatic home washer. The fabrics were a rayon-

rayon, same as in Part I, a nylon power net with rayon-covered rubber yarns (nylon-rayon), a nylon power net with cotton-covered rubber yarns (nylon-cotton), and a nylon power net with nylon-covered Fiber K* yarns (nylon-Fiber K). In addition to those properties mentioned in Part I, bursting strength and elongation were measured on samples withdrawn after 0, 1, 10, 20, and 30 washings.

The nylon-Fiber K fabric was highest in elastic recovery. Of those fabrics containing rubber, the nylon-rayon excelled.

Although shrinkage was much greater fillingwise than warpwise, all dimensional changes were excessive. The nylon-cotton best retained the warp dimension and nylon-Fiber K the filling.

The nylon-cotton changed least from the original in color with the change being in the yellow direction.

The nylon-cotton exhibited highest bursting strength through all treatments, however the nylon-rayon changed least from the original.

The nylon-Fiber K best retained the original elongation, however, the nylon-rayon and nylon-cotton continued to have the highest elongation.

Although the rack-drying method was superior to tumble drying in all properties except elastic recovery, the differences between the methods were small. Thus elastic fabrics may be safely tumble dried provided they are not overdried.

The rayon-rayon fabric, washed in both the Launder-Ometer and the automatic washer, provided a basis for comparing the two washing methods. The Launder-Ometer method produced more elastic recovery and less filling shrinkage; and the automatic home washer method produced less initial and permanent set, less warp shrinkage, and less color change.

Further investigation is recommended to determine the effect of wear, body oils, and perspiration upon the physical properties of elastic fabrics.

Microfilm \$3.25; Xerox \$11.00. 249 pages.

*A trademark used by E. I. DuPont de Nemours and Company.

JOURNALISM

AN ANALYSIS OF THE MARKET NEWS SERVICE FOR LIVESTOCK AND GRAIN IN OHIO WITH SPECIAL REFERENCE TO THE MEDIA OF RADIO AND DAILY NEWSPAPERS

(L. C. Card No. Mic 59-2298)

Francis Burwell McCormick, Ph.D.
The Ohio State University, 1953

The objectives of the dissertation are fivefold: (1) to review some problems concerned with farm market reports in Ohio; (2) to obtain an inventory of the sources of livestock and grain market information available to Ohio farmers; (3) to determine the extent to which available sources of livestock and grain market information are now being used by farmers; (4) to obtain from producers suggestions as to how the market news service for livestock and grain might be expanded and improved; and (5) to make recommendations as to possible ways of improving the market reporting service for livestock and grain.

Four sources of material were drawn upon to accomplish these objectives. They were: (1) published and unpublished information already available; (2) personal interviews with personnel at 67 Ohio radio stations; (3) an examination of 76 of the approximately 100 daily newspapers published in Ohio; and (4) personal interviews with 656 Ohio farmers.

Livestock

Limited information available indicates there is a difference in prices paid farmers for hogs of the same weight or grade between terminal markets, between local markets, and between terminal and local markets in Ohio. It is assumed these differences are as great for other species of livestock. Thus, there is need for a market reporting service in Ohio to enable farmers to sell at the market which will yield the greatest net returns. Personnel engaged in reporting markets are in need of information concerned with the type of market news farmers use and want reported.

One livestock market reporter employed by the Production and Marketing Administration of the United States Department of Agriculture is located in Ohio and stationed in Cincinnati. Information prepared by this reporter comprises a relatively small part of the livestock market news released to the Press Associations from the regional office of the Production and Marketing Administration in Chicago. Much of this information does not reach interested farmers. Market information concerned with other livestock markets in Ohio, where available, is prepared and released by personnel whose primary business is other than that of market reporters.

The inventory indicated that approximately two-thirds of the radio stations in Ohio reported some type of livestock market news and devoted an average of about four minutes per day to such reports. The average number of daily broadcasts per station was 1.5, one-half of which

occurred during the noon hours, between 11:00 a.m. and 1:00 p.m.

Markets most often reported were Cleveland, Chicago, Cincinnati, Columbus, and Indianapolis. In addition, about one-third of the stations reported a local market located in the same county as the radio station. Approximately one-half of the stations reported information concerned with only one market.

Some radio reports were not as complete in other respects as they might have been. Reports for some markets did not always include all species of livestock sold at the respective markets. Some stations quoted prices but did not quote receipts, while at other stations receipts were quoted without comparable price data. Trends of prices and receipts were not always reported, although price trends were given more often than receipt trends. Approximately one-third of the radio stations reported the latter.

Livestock market news was reported by approximately three-fourths of the daily newspapers published in Ohio. Markets most often reported in newspapers were generally the same as those reported by radio stations. Approximately one-half the papers carried a report for only one market.

Many newspaper reports were incomplete, as evidenced by the fact that the number of classes and grades of each species of livestock reported per newspaper varied to a considerable extent. The situation regarding price and receipt trends was similar to that in existence for radio reports, in that many papers did not carry both items. Receipt quotations for local markets were reported by approximately 50 per cent of the papers which carried local reports.

The timeliness of newspaper reports was about as good as could be expected, in that nearly all afternoon editions reported conditions for the current day. Newspapers published during the early morning period, of necessity, reported market conditions for the previous day.

Radio was considered the most important single source of livestock market news and was used by about 75 per cent of those who sold livestock. This was a higher percentage than for any other medium, and more farmers gave it a higher rank than for any of the other sources. Approximately two-thirds of the farmers who listened to the radio for livestock market information indicated they were regular day-to-day listeners throughout the year.

Daily newspapers were the second most used source of livestock market information and were used by approximately 60 per cent of those farmers who sold livestock. Most farmers ranked this medium second among the sources used. About one-fifth of the readers considered it their most important source. Nearly 90 per cent of these readers indicated they were constant day-to-day readers throughout the year.

The third and fourth most used sources of livestock market information were farm papers and telephones in that order of importance. The Ohio Farmer was the farm paper read most and the Farm Journal was second.

In the section of the study concerned with information

farmers want in a livestock market report it was indicated that almost 80 per cent wanted their favorite radio station to broadcast livestock market news. This figure represented almost all farmers who sold livestock. More than one-half of the farmers wanted two or more daily broadcasts and the noon hour was the first choice of time of day for the reports.

Approximately one-third of the operators wanted reports from three or more livestock markets. Markets most often mentioned in the order of the number of times they were listed are: Local, Columbus, Cleveland, Cincinnati, and Chicago.

A majority of operators suggested that actual prices and actual receipts for each market be quoted in radio broadcasts of livestock market news. This was in contrast to reporting only trends for some or all of the markets. Farmers suggested that when radio personnel quote prices, a range by grade be given together with a price for which most of the grade is selling.

Farmers wanted other items included in livestock market broadcasts. One such item was a desire on the part of almost 90 per cent of the operators for price trends. A few less asked for both actual receipts and a receipts trend. Somewhat fewer, but still a majority, asked for a summary statement of conditions on the large livestock markets.

Approximately two-thirds of all farm operators suggested that daily newspapers carry livestock market reports. The type of report asked for was very similar to that requested from radio stations.

Grain

The Production and Marketing Administration does not have a grain market reporter in Ohio. Most of the official grain market news available to producers in the state originates at the regional office of the Production and Marketing Administration in Chicago. Much of this information does not reach farm operators.

The inventory of grain market information indicated that fewer Ohio radio stations reported this type of news than reported livestock market information. Almost one-half of all stations reported some grain market news on a total of 52 daily programs, which averaged slightly over one minute in length. One-half the programs were broadcast during the noon hour, between 11:00 A.M. and 1:00 P.M.

The Chicago Board of Trade futures prices item was the grain market news most often reported by radio stations. Such information was included in more than two-thirds of all grain programs. No radio station reported more than two cash grain markets and Chicago and Toledo were the two markets most often reported. Almost one-half of the stations reported information for a local cash grain market. The grade of grain for which quotations were given was reported on only 10 per cent of the programs which reported local market information.

About 60 per cent of the newspapers reported some type of grain market information and the item of news most often given concerned futures quotations on the Chicago Board of Trade. Almost two-thirds of the papers which reported grain market news carried a local report. Most of these papers reported prices for only one firm.

Information for some grains was not always included in newspaper reports. This was especially true for local reports and was often true for reports from terminal mar-

kets. The number of grades of each grain reported was usually small, with the usual number for terminal markets two. One grade was the number most often given for local reports. Grain price and receipt trends were usually not included in newspaper reports.

A total of 49 per cent of the farmers who sold grain indicated they obtained information from a bulletin board at a local elevator before making the decision to sell. This was the most often used source of grain market information. The second most mentioned source of grain market news was the daily newspaper. It was read by 47 per cent of the farmers who marketed wheat, most of whom said they followed the grain market day-to-day throughout the year. Radio was the third most used source of grain market information and was used by approximately 30 per cent of those who sold wheat. Most farmers who used this source of information indicated they were regular day-to-day listeners throughout the year. The telephone was the fourth most used source of grain market news.

In the section of the study concerned with information farmers want in grain market reports, it was indicated that slightly more than one-half of all farmers asked for a radio broadcast of grain market news. It was suggested that the reports be broadcast daily throughout the year rather than have them limited to the heavy grain marketing season. Slightly more than one-third of these farmers wanted two or more daily broadcast and most farmers suggested these broadcasts should occur during the noon period.

The markets from which most farmers wanted grain market information were Chicago, Toledo, Columbus, Cincinnati, and local. Grains for which reports were requested were wheat, corn, soybeans, and oats. A few farmers also asked for reports on rye and barley.

About two-thirds of the operators asked that the grade of grain be specified and that an explanation of discounts be given in any radio reports. Almost one-half wanted Chicago Board of Trade futures price quotations included.

Slightly less than one-half of all operators wanted daily newspapers to carry grain market reports, with the type of report requested having been similar to that desired from radio.

Recommendations

1. Some radio stations should allocate more time and some newspapers more space for livestock and grain market reports if complete coverage is desired.
2. A minimum of three daily markets news broadcasts is needed from any radio station whose goal is complete and timely livestock and grain market coverage for its listeners.
3. Information for more markets should be included in the reports of some radio stations and some newspapers.
4. Local livestock and grain markets should be included in both radio and newspaper reports.
5. Data for all species of livestock traded at a specified market should be made a part of the report for that particular market.
6. When quoting prices, a range of prices should be given for each grade of livestock together with a price for which most of the grade is selling.
7. Livestock receipts should be quoted for all markets for which price data are given.
8. Consideration should be given the possibility of

- reporting receipts for each grade of the various species of livestock at each market.
9. Price and receipt trends both should be made a part of livestock market reports.
 10. A summary statement reviewing conditions on the large terminal markets in the mid-west should be made a part of any livestock or grain market report.
 11. The mid-morning period should be given special consideration as a possible choice of time for a radio broadcast of livestock market news by some radio stations.
 12. Improved accuracy of livestock and grain market reports should be a goal of all radio stations and all daily newspapers.
 13. Cash prices at a large grain terminal should be included in any grain report.
 14. Grain market reports should include quotations for all grains traded at any market for which reports are given.

15. Grades of grain should be specified when grain prices are quoted.
16. Discounts in quoted grain prices due to excess moisture or foreign material should be explained in radio and newspaper reports.
17. Futures price quotations should be included in grain market reports.
18. The Ohio Department of Agriculture or the United States Department of Agriculture, or both agencies on a cooperative basis, should give consideration to the employment of a number of market reporters who would work with the market agencies and the media of market news dissemination to bring about adoption of the preceding recommendations.

Microfilm \$5.35; Xerox \$18.80. 420 pages.

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LANGUAGE AND LITERATURE, GENERAL

**FAIRE EM: A CRITICAL EDITION, WITH AN
INTRODUCTION ON THE AUTHORSHIP
OF THE PLAY.**

(L. C. Card No. Mic 59-2003)

Robert William Barzak, Ph.D.
University of Illinois, 1959

This edition presents a critical text of *Faire Em*, based on a microfilm of the unique undated quarto (Q1) now in the Bodleian Library. The copy-text has been collated with four copies of the 1631 quarto (Q2), but since this was a mere reprint it has played no material part in the construction of the text. However, in the Textual Notes I have listed all the substantive variants in Q2 and all the modern editions, as well as those variants of accidentals which may, in my judgement, affect the meaning. In addition to the Textual Notes, the textual paraphernalia includes a list of all variants in accidentals between Q1 and Q2, a separate transcription of Karl Elze's metrical reconstruction of II, ii, and a list of emendations of accidentals made in the copy-text. In the introduction special attention has been paid to the claim of William Rufus Chetwood made in 1750 that he had seen and used a 1619 edition; a close study of his text reveals that in fact, his text is based on nothing more than a modified version of Q2, "corrected" in line with common eighteenth-century editorial practice. However, for the sake of historical completeness, I have included in the Textual Notes Chetwood's variant readings. Also in the first part of the introduction, I have attempted to demonstrate that *Faire Em* is a "bad" quarto, reconstructed memorially by the actors who played William the Conqueror and Em, perhaps with the aid of actors' "parts," and that, furthermore, it is a memorial reconstruction of an abridged version of the original play, concocted for the use of a troupe of actors touring the provinces in 1592 or 1593.

In the second part of the introduction I have discussed the probable date of composition and have placed it in 1590, because of its imitation of Greene's *Friar Bacon* (c. 1589) and the same author's remarks about the author of *Faire Em* in the Epistle to his Farewell to Follie (1591). Next, I have taken up the question of authorship, and, after reviewing the arguments for the three most common ascriptions—to Greene, Shakespeare, and Robert Wilson—have attempted to demonstrate that they are either impossible or highly implausible. Instead I have proposed Anthony Mundy as the author. Evidence for this proposal is to be found, I believe, in similarities with plays attributed to Mundy, particularly *John a Kent* (c. 1589); and in the identification of Mundy as the unnamed target of Greene's satire in the Epistle prefixed to *Farewell to Follie* (1591). And last, I have established that Mundy probably used for one of his plots "The Fourth Historie" from Henry Wotton's *A Courtlie controuersie of Cupids Cautels* (1578), rather than the French original, and, as most recent editors of

the play have stated, a lost ballad, "The Miller's daughter of Manchester" (S. R. March 2, 1581) for the other plot. The story from Wotton is reproduced in an appendix.

In the Critical and Explanatory Notes I have recorded significant parallels between *Faire Em* and Mundy's plays and between *Faire Em* and *Friar Bacon* and Greene's other plays. In addition to these parallels, I have shown in the notes how extensively Mundy used proverbial matter and have discussed the most puzzling textual problems in the play. Microfilm \$3.90; Xerox \$13.40. 307 pages.

A BASIC VOCABULARY OF RUMANIAN

(L. C. Card No. Mic 59-2230)

Prior Maximilian Hemsley Edwards, Ph.D.
University of Pennsylvania, 1959

Supervisor: Professor A. G. Juillard

Quantitative analyses of languages have been limited to lexical counts of dictionary forms. Because of this, investigations at sub-lexical levels have been unreliable, and supra-lexical analyses have been virtually impossible.

Our specific purpose was the compilation of a frequency dictionary of Rumanian, from which a basic vocabulary of the language might be determined. The general purpose was to elaborate a technique useful to analysts wishing to undertake further investigations. The present study is a part of a project being conducted at the University of Pennsylvania, which seeks to make parallel investigations of five Romance languages.

Five principles are outlined: 1) The universe should be homogeneous in time and space, covering as many aspects of life as possible; 2) The corpus selected from the universe by statistical methods should be sampled to facilitate lexical, sub-lexical and supra-lexical analyses; hence, the main unit is not the word, but the sentence; 3) The identification of words out of context should be effected by two coding systems: (a) to distinguish indispensable semantic information for similar words within a grammatical category, and (b) to mark the difference between the functions of similar words belonging to different parts of speech; 4) All words should be recorded and coded, so that a complete analysis may be envisaged; 5) As 97.5% of any corpus consists of its 4,000 most frequent words, we decided to limit the basic vocabulary to the first 5,000 items.

Comparative Romance studies have been deprived of valuable essential information because of the paucity of analyses of Rumanian. In spite of the fact that this language has imported non-Latin elements and is an interesting specimen of a language in contact with extraneous linguistic systems, it displays conservative tendencies in its phonetic development and is valuable to Romance philologists. Now that the Bucuresti dialect has become standard Rumanian, a focal point exists from which more exhaustive

analyses may be made; moreover, it will be possible to measure the degree of latinity of Rumanian.

The corpus was drawn from prose literature within five main categories: drama, fiction, non-fiction, technical works, and journalism; we regarded all printed matter in Rumanian as a general universe, and from that we sampled from works published between 1900 and 1940. Under the direction of a statistician books were drawn from the universe, and a sampling technique was elaborated. From each of the five literary categories we sampled 100,000 words (including the punctuation), and our units were complete utterances. The material was placed on I.B.M. cards in phonological code, and it was then transferred to electromagnetic tapes for further processing through the electronic computer.

When the corpus had been transferred to tapes and stored in the memory of the computer, the latter was instructed to give a list of all the word-forms, in descending order of frequency. Inflected forms etc. of all words were then grouped under their respective dictionary-forms, and a list was edited showing the total for each entry-word, as well as separate totals for each variant, broken down for each literary category. An alphabetical list of entry-words was given, showing each word's rank, range, literary distribution, and the number of forms in which it appeared.

Previous frequency counts have usually given only totals for dictionary-forms, and have usually eliminated words of very high frequency. We believe that this study is of more potential usefulness because it accounts for all words, all inflected forms and variants, and shows the distribution of words within five separate literary categories. Finally, by including punctuation symbols, this count will facilitate syntactical and even intonational analyses of the language.

Microfilm \$8.60; Xerox \$29.20. 680 pages.

A CRITICAL EDITION OF BROME'S THE NORTHERN LASSE

(L. C. Card No. Mic 59-2443)

Harvey Fried, Ph.D.

New York University, 1959

Adviser: Professor Elkin C. Wilson

Although Richard Brome's comedy, *The Northern Lasse*, was often published in the seventeenth and eighteenth centuries, it has never been carefully edited. The play last appeared in the 1873 Pearson reprint of *Brome's Dramatic Works*; but Professors T. M. Parrott and R. H. Ball tersely call that work "unsatisfactory." My dissertation embraces an introduction, the text of the play, an appendix (containing the 1684 prologue and epilogue), and explanatory notes. My text is neither a facsimile nor a modernized one; it is a critical text. I have used the first quarto of 1632 as my copy-text; it is the only edition that has any authority, as the second quarto of 1663, and the third quarto of 1684 are, as I argue, merely copies of it.

The Northern Lasse was first mentioned in Sir Henry Herbert's *Dramatic Records* in 1629, and though Brinsley Nicholson attempted to prove that it was written in 1624, his evidence was slight and ambiguous. In its own time, the play was a favorite with both courtly and common audiences;

after the Restoration, it was reprinted with a new prologue and epilogue, one of the few Caroline plays so honored. The comedy retained its popularity in the early eighteenth century: during the 1704-1705 season, when *Henry IV* was given three times, and *Bartholemew Fair* and *Volpone* but twice, *The Northern Lasse* was produced nine times. The play finally left the boards in 1738.

More than two hundred years ago, Gerard Langbaine said of Brome, "His Plots are his own"; this judgment has not been substantially altered. So far, it has been impossible to point out a definite source for *The Northern Lasse*. Brome was, nevertheless, a servant of Jonson in more ways than one; throughout Brome's comedies one is aware of an indebtedness to Jonson, especially in choice and delineation of characters. In *The Northern Lasse*, Anvile, a miles gloriosus, is probably modelled on Captain Bobadil; Widgine, the wealthy gull, is based on Stephen and Matthew in *Every Man in His Humour*. However, for his heroine, Constance, who goes temporarily insane, Brome turned to Shakespeare's Ophelia and the jailer's daughter in *The Two Noble Kinsmen*.

Possibly some of Brome's stage techniques were employed by James Shirley, but the literary influence of *The Northern Lasse* is most evident after the Restoration. Like *The Northern Lasse*, *The Mistaken Husband*, a comedy attributed to Dryden, includes an unconsummated marriage, a divorce or the appearance of one, and the prospect of a second marriage. The theme of unconsummated marriage also appears in Aphra Behn's *The Town-Fopp* which may too have been based on Brome's comedy.

Brome is essentially a transitional playwright, a link between the Jonsonian comedy of humours and the Restoration comedy of manners. Like Jonson, from whom he learned his dramatic technique, Brome was highly adept at manipulating complicated plots; witness *The Northern Lasse*. Lacking Jonson's moral depth, Brome was closer in tone and attitude to Thomas Middleton, although he has a note of romanticism alien to both Jonson and Middleton. Nevertheless, like Middleton, Brome was amused at the arriviste who wished to be accepted by the upper classes; indeed, *The Northern Lasse* is perhaps most noteworthy for the wit and sharpness of its social commentary. Unlike greater dramatists Brome did not create comic worlds, but merely satellites, charming but lacking a light of their own; he had talent, not genius -- industry, not vision.

Microfilm \$3.55; Xerox \$12.00. 273 pages.

A HISTORY OF BIOGRAPHICAL COLLECTIONS FROM THE BEGINNING THROUGH THE BIOGRAPHIA BRITANNICA

(L. C. Card No. Mic 59-2444)

Sanford Golding, Ph.D.

New York University, 1959

Adviser: Edward L. McAdam, Jr.

The concept of the dictionary of biography as a reference work is a fairly recent one; yet, biography itself began in early Greece with short lives in collected form. The development of the form was slow and often devolved, and in its meandering produced not only the biographical

dictionary but the modern encyclopedia as well. Early Greek and Roman collections of lives, although anecdotal in character and often polemic, led directly to the impersonal and stereotyped ecclesiastical collections, of which St. Jerome's *De Viris Illustribus* was the prototype. More bibliographical than biographical, the original purpose of these works was to prove the erudition of the Church fathers. These collections, in turn, served as models for two new forms, the bibliographical works of men like John Boston and Conrad Gesner and the biographical works of the English antiquaries, John Leland, John Bale, and John Pits. The two forms were at first almost identical, and both differed little from their ecclesiastical models. From out of the antiquarian tradition sprang a large number of polemical collections, both Protestant and Catholic, and later political, of which the icon or portrait books were a popular kind. Simultaneously, in the sixteenth century, there appeared works of a broader scope which combined geographical and historical names to the biographical, in alphabetical order, of an encyclopedic nature. Although forms of this last kind trace back to classical times, the first of the modern ones and the most influential was that of Charles Estienne.

The seventeenth century was prolific in the production of both the biographical and the encyclopedic collections. The vulgar languages began to replace Latin. Juigné produced a work on the order of Estienne's for the unlearned, expressly as a reference work, and Thomas Fuller, in English, wrote an entertaining, anecdotal compendium of biography and general information. In the meanwhile, specialized collections, particularly lives of poets, abounded. These reached a culmination of scholarship and accuracy in the end-of-the-century *Athenae Oxonienses* of Anthony Wood. At the same time, two men, Louis Moreri and Pierre Bayle brought the form of the encyclopedic dictionary to a new maturity. Moreri's work was broad in scope and convenient to use. After his death, many of the foremost scholars of Europe improved upon his plan, and by 1759, the work, still bearing his name, contained ten folios. Bayle brought to the tradition a modern scholarly technique, scrupulously accurate and honest, combining the quotation of letters and documents with a healthy skepticism toward secondary sources rarely seen before.

Bayle and Moreri both had a tremendous influence upon eighteenth century scholarship. From their works came the impetus for both the French *Encyclopedie* and the English biographical dictionaries. The *General Dictionary*, planned as a translation of Bayle, included about nine hundred additional lives, using the Bayle method of extended commentary notes, which enabled the editors to treat their subjects in detail, through the use of correspondence and quotations from writings. The *Biographia Britannica*, following upon its heels, continued the same form, but restricted itself to Englishmen, the first dictionary of national biography of its kind. Moreover, the contributors were often authorities on the subjects they handled. The lives were even longer, more detailed, and more profusely documented than in the former works. As a form, the *Biographia* soon gave way to the shorter, more matter-of-fact articles in the collections that followed, but most of its successors borrowed freely from its pages for material.

Microfilm \$3.30; Xerox \$11.20. 254 pages.

VISION AND INTELLECT: THE ROLE OF MYSTICAL EXPERIENCE IN THE WORK OF SAMUEL TAYLOR COLERIDGE

(L. C. Card No. Mic 58-7849)

Richard Haven, Ph.D.
Princeton University, 1958

Basil Willey has said that for most writers the 'character of the metaphysical superstructure' is originally determined not by an intellectual process but by 'something sublogical.' If we are fully to understand a writer, we must understand not only the conceptual systems with which he was familiar and the arguments which he derived from them, but also the character of the universe which he experienced and which in his writing he tried to express or explain. For Coleridge, experience of the universe included an intuitive awareness of a transcendent reality. Examination of moments of experience which he supposed to involve such awareness reveals an experiential structure which is reflected throughout his poetry and metaphysics and which provides a basis for the interpretation of some aspects of his poetry and his theory of poetry.

Moments of experience involving intuitive insight are the hub around which a large proportion of Coleridge's poems revolve. These moments exhibit qualities clearly differentiated from those of ordinary 'normal' experience. A study of the writings of various mystics shows that these same qualities, though variously expressed, are characteristic of what is called 'mystical' experience. This suggests that in Coleridge the original 'sublogical something' that determined the character of the 'metaphysical superstructure' was the experience of states of consciousness like those of mystical experience, and, further, that certain notions about the nature of reality and about the relations between universal and particular, essence and existence, may be in part derived from and determined by such experience.

Coleridge did not, however, consider himself a mystic. Intellectually, he was a child of the 'enlightenment.' In the world bequeathed to him by Hobbes and Newton and Locke, he found neither the language nor the beliefs of traditional mysticism available. For him, the unknown must be made intelligible not in terms of some schema of the supernatural, but in relation to the 'known' of ordinary experience. And his philosophy may be seen as the result of his attempt to describe and explain the character of mystical vision not as part of theological dogma but as empirical fact. Viewed in this way, Coleridge's early devotion to Hartley no longer appears as an intellectual enthusiasm at odds with his romantic and transcendental inclinations. Nor does his later devotion to German metaphysics involve the discovery of a 'new view of the world.' His metaphysical speculations appear as parts of a coherent attempt to find an acceptable means of expressing and explaining a view of the world which he found in his own experience.

Coleridge never constructed a new system of philosophy. But as his metaphysical ideas grew out of or were determined by the same distinctive kind of experience that provided the impulse of his poetry, so they provided him with a language in which he could discuss his experience as a poet and a reader of poetry. If Coleridge's discussions of imagination, of symbols, of organic form are read with reference not simply to the concepts of his

metaphysics, but through those concepts to the experiential facts of which they are themselves symbolic, then the problem with which his aesthetic and critical writings deal and which they illuminate is seen to be the same problem which he faced as a poet--the expression in discursive language of 'mystical' or non-discursive states of consciousness.

Microfilm \$3.30; Xerox \$11.20. 255 pages.

CRITICAL THEORY AND PLAYWRITING PRACTICE
OF CONTEMPORARY AMERICAN PLAYWRIGHTS:
A STUDY OF THE RELATIONSHIP OF CRITICAL
THEORY TO PLAYWRITING PRACTICE AS
EVIDENCED IN THE PRIZE WINNING PLAYS OF
CONTEMPORARY AMERICAN PLAYWRIGHTS
DURING THE YEARS 1920-1940

(L. C. Card No. Mic 59-1014)

Arthur Jasspé, Ph.D.
New York University, 1958

Chairman: Professor Fred C. Blanchard

This study is an investigation of the relationship of critical theory to playwriting practice in the cases of eleven contemporary American playwrights during the years 1920-1940.

These playwrights are authors, who, in this time period have had four or more plays selected for the Pulitzer Prize for Drama, the New York Drama Critics Circle Prize for Drama, and Burns Mantle's annual listing of the ten best plays. Thus, an objective selection of plays and playwrights was obtained.

The playwrights studied, and the number of plays each one has on the prize-winning lists taken together, are: Maxwell Anderson (11 plays), Philip Barry (8 plays), S. N. Behrman (5 plays), Marc Connelly (5 plays), Rachel Crothers (6 plays), Sidney Howard (5 plays), George S. Kaufman (17 plays), George Kelly (4 plays), Eugene O'Neill (8 plays), Elmer Rice (4 plays), and Robert E. Sherwood (7 plays), a total of eleven playwrights and eighty-one prize-winning plays.

Although some of these authors are deceased, others are very much active in the theatre. Both Maxwell Anderson, with *The Bad Seed*, and George S. Kaufman with *Silk Stockings*, *The Solid Gold Cadillac*, and his direction of *Romanoff and Juliet*, have scored recent successes in the theatre. And Eugene O'Neill, in 1957, was posthumously awarded the Pulitzer Prize for *Long Days Journey into Night*.

The critical writings of these playwrights, that is, their non-dramatic writings dealing with the technique and philosophy of the drama, were examined and the conclusions they reached in these writings obtained. Evidence of the use of these conclusions was sought in the prize-winning plays of these authors so that the principles of playwriting practice used by each of these playwrights in the writing of their prize-winning plays could be found.

A consensus of opinion of the playwrights studied concerning their principles of playwriting practice was taken. The greater consensus of opinion, that formed by six or more of these playwrights, was found to indicate a general agreement in regard to principles of playwriting practice

used in the writing of their prize-winning plays. The lesser consensus, then, gave evidence of individual style in playwriting, for the same playwrights appeared on both lists.

In its conclusions, this study found the playwrights, in greater consensus, agreeing that a play should be based on an idea, built around a central character, told in terms of action, with the audience kept in mind, and written with a view to the practicalities of unified production. And the prize-winning plays, in their aggregate content, were found to be arranged in line with the greater consensus of the playwrights studied, that is, in accordance with the forms they have prescribed as the general basis for playwriting practice.

With these conclusions, therefore, if a playwright were to follow the general basis for playwriting practice given in the greater consensus of opinion of the playwrights studied, and vary his writing with the individual facets of playmaking given in the lesser consensus, he would then be on the way toward developing his own particular style of playwriting and making of plays.

For in its conclusions, this study has brought forth the general basis and fundamental structure of the craft of contemporary playwriting in America as exemplified in the stated theories and in the practice of its most successful dramatists.

Microfilm \$5.45; Xerox \$19.00. 425 pages.

THE "GREAT MAN" IN ENGLISH SATIRE,
1710-1743

(L. C. Card No. Mic 59-2244)

Kenneth William Keuffel, Ph.D.
University of Pennsylvania, 1959

Supervisor: Professor Maurice Johnson

For nearly twenty years before his fall from power in 1742, Sir Robert Walpole was widely satirized in England as the "Great Man." During his later years in power the mere mention of "Great Man," or even of "Great" or "Greatness," often directed the reader's or the hearer's attention to the chief minister. But long before Walpole's rise to power English moralists had been concerned with the problem of false greatness, and, naturally enough, English satirists had attacked other "great men." Nor did the satiric treatment of this theme end with Walpole's fall from power in 1742; it merely resumed its former universal application. The first part of this study is a brief historical survey of the "great man" theme in English satire before, during, and after the Walpole period.

After this historical survey I have studied in turn the varied writings of Jonathan Swift, John Gay, and Henry Fielding as a background for a consideration of *Gulliver's Travels*, *The Beggar's Opera*, and *Jonathan Wild*, which would surely appear to be the three masterpieces of this satiric genre. The years 1710, as a beginning, and 1743, as an ending, are not intended to be rigid limits but rather to indicate the best place of focus for this study. 1710 saw the beginning of Swift's activities as a political writer, with his attacks on such "great men" as the Earl of Wharton and the Duke of Marlborough; and 1743 marked

the culmination of "great man" satire, with the publication of Fielding's *Jonathan Wild*.

In their ceaseless attacks on false greatness Swift, Gay, and Fielding were not innovators: they were, in fact, following the example of a long line of moralists and satirists before them who had called for exemplary conduct and responsible leadership from the aristocracy. Eighteenth century moralists taught that those who by birth or ability held high rank in the social hierarchy and the national government had an ingrained obligation to live up to their high station. That was the true meaning of *noblesse oblige*. In attacking those in high station who acted less nobly than they should, these satirists were anything but levelers: on the contrary, they were actually attempting to preserve the long-established and valid social hierarchy in which they firmly believed.

What differentiates this satire from other satire on ignoble men in high places is that for a considerable period a few selected individuals were attacked in a certain way, with the attacks usually involving a special and ironic use of "great" and "great man." In this specialized usage "great man" was, of course, almost invariably used in a pejorative sense. And for almost twenty years the GREAT MAN, especially when written in capitals or italics, was Sir Robert Walpole.

Microfilm \$3.15; Xerox \$10.80. 243 pages.

THE FUNCTION OF THE CONCEPT OF ORGANIC UNITY IN THE WRITINGS OF JOHN RUSKIN BETWEEN 1857 AND 1870

(L. C. Card No. Mic 59-913)

Sister Mary Eileen Neville, O.S.B., Ph.D.
St. Louis University, 1958

This dissertation, through a study of John Ruskin's writings between 1857 and 1870 represent an orderly development of his thought. This study reveals that Ruskin's repudiation of the social philosophy of his age in 1860 was not the abrupt *volte-face* that several scholars have suggested. Rather, it was part of the continuous development of his concept of organic unity, which began taking shape in his early twenties and gradually expanded, acquiring peripheral concepts, until in his late forties it became the central archetype of all his writings.

The organic concept, which Ruskin unconsciously absorbed from his Romantic predecessors, was a tendency to visualize the structural organization of nonorganic entities in terms of the unity found among members of vegetal and animate organisms. This tendency identified him with the long-standing Humanist tradition and with the anti-Liberal position of his contemporaries, particularly with such essayists as Coleridge, Carlyle, Newman, and the Arnolds.

Ruskin began to assume an organic view early in life with the disintegration of his Calvinistic religion. At that time occurred in his thought three important changes which formed the nucleus of his later speculation: shifts from Calvinism to anthropocentric humanitarianism, from a theocentric to an anthropocentric view of the universe, and from art to society as the center of his interest. Concomitantly with these changes, the principal archetype of his

thought changed from a Lockean mechanistic construct to an organism. This dynamic figure increased in importance until it dominated his whole thought pattern. However, as its applications broadened they became less distinct. Ruskin first applied the organic concept to aesthetics in the 1840's, showing that the work of art must possess unity, and that a similar unity exists between work and artist, and between artist and society. This preoccupation led Ruskin in the 1850's and early 1860's into a socio-economic study of the State, which he found to be structured analogously to man. In the later 1860's he attempted to explain the totality through the pattern of the organism.

The organic orientation of Ruskin's thought led him consistently to employ analogical and metaphorical modes of expression. From the simple vegetation similes of his early art criticism, through the more forced similes and metaphors based upon the human body in his socio-economic theorizing, to the elaborate allegories and mythical personifications of his later quasi-philosophical writings, his use of organic imagery continuously grew in intensity and complexity. This impeded full communication with his casual audience, resulted in general misunderstanding of his later works, and led to the erroneous conclusions that these writings sprang from a demented mind and are dissociated from his earlier thought.

On the contrary, this study shows that Ruskin's writings are a single development, representing a continuous attempt to see in the universe a unified pattern. His basic principles and his means of expression--the concept of organic unity and the organic image--remained the same throughout his career; their details varied to serve his changing interests.

Microfilm \$5.60; Xerox \$19.60. 440 pages.

HJALMAR HJORTH BOYESEN: CRITIC OF LITERATURE AND SOCIETY

(L. C. Card No. Mic 59-2452)

Marc L. Ratner, Ph.D.
New York University, 1959

Adviser: Professor William Gibson

The subject of my study is the criticism of Hjalmar Hjorth Boyesen (1848-1895), a Norwegian-American critic, author, and teacher. The influence of this writer on American letters has been neglected or at best only slightly touched upon by critics and literary historians interested in literature of the late nineteenth century.

Boyesen, who began his literary career as a romantic, ran through the gamut of late nineteenth century views on literature. The transition from "moonlight romanticism," to realism is evident in his first novel, *Gunnar*, romantic in style and narrative, but dedicated to Turgenyev. He was interested in Zola, but only when he was violently reacting to romantic attacks did he cite the naturalist as a great writer. His course of development was uneven because he retained traces of his early romanticism, even when defending realist writers. He was essentially a realist of Howells' group, but a realist unique in his European background. It is this very background which makes him an important contributor to the realist movement in America.

His essays provided a steady source of critical information about what was taking place in European letters, and his sense of literary history guided his readers in evaluating the importance of the realistic literary movement.

Behind most of Boyesen's ideas, social and literary, lay his belief in Spencerian evolutionary progress. His views of political change in theory and practice in America were clearly governed by the Spencerian view of the new complex industrial society which would replace the outworn institutions of the past. America's sociological process of "Americanization," or assimilation of culture, was part of the evolutionary process. He felt the process threatened by unrestricted immigration, and despite his sympathies and background, advocated restriction in immigration as necessary.

Among his other interests was his belief in the new role of woman in society, and the need for education on all levels to prepare men for the new and better world of the twentieth century. Literature was to contribute to this education by dealing with social issues. Boyesen was also anxious to see the growth of a corps of critical experts to deal with the growing specialization of the times--experts whose range of literary sensitivity would cover foreign as well as American authors, and who would be able to compare literature on a world, rather than on a national, basis. He associated the rise of realistic fiction with the growth of American letters. Since some American novelists had chosen to abandon the spirit of romance and devoted themselves to studying and chronicling social conditions, Boyesen believed that the American novel would soon command the attention of the entire civilized world. Like Taine, Boyesen believed that literature is the autobiography of the race, and he wanted an American literature that would stand on its own feet.

Through his fiction and criticism, Boyesen attempted to exemplify and explain the role of literature in society. Again and again, he emphasized social values over those of the romantic individual, who, he felt, often impeded rather than furthered the progress of mankind. He saw in realism a great educative force which would make man aware of his place in history and his part in evolution.

Microfilm \$3.35; Xerox \$11.40. 257 pages.

**THE DRAMATIC UNITIES IN THE RENAISSANCE:
A STUDY OF THE PRINCIPLES, WITH APPLICATION
TO THE DEVELOPMENT OF ENGLISH DRAMA.**

(L. C. Card No. Mic 59-2053)

James Edward Robinson, Ph.D.
University of Illinois, 1959

The principles of the dramatic unities have had a long life, gaining particular prominence from the sixteenth to the eighteenth centuries. The purpose of this study is to give thorough examination of these dramatic principles of unity of structure and limitation of the representation of time and place in the Renaissance period in which they were codified.

First, on the background of traditions in staging and the desire to imitate classical structure in drama, the development of the theory of the unities by Italian literary critics of the sixteenth century is traced. These Italian

critics based their thought mainly on the poetics of Aristotle and Horace. The rules of the unities that they formulated were passed on to England and France in the late sixteenth and early seventeenth centuries. However, it is clear that these concepts of structural unity and of continuity in time and place owed much to the study of Roman and Greek drama. The fullest and most influential study was that of the Roman comedies of Terence. A vast body of commentaries on his plays, commentaries that were based on the work of the fourth-century grammarian and critic Donatus, grew from the beginning of the sixteenth century in various European countries. Chapter III of this study details the foundations of the principles of the dramatic unities in these commentaries.

With this rather full background of the critical thought of the period, the last chapters of this study examine what place the classical principles of the unities had in the development of English Renaissance drama. Even before the Italian rules of the unities were fully developed, it is clear that there was a consciousness in England of the principles and importance of the unities. The development of English drama can thus be partially explained in the clash between the desire to imitate classical form, such as represented by the unities, and medieval, romantic, and historical materials and tendencies. The plays and theories of Ben Jonson, finally, are studied as a conclusion and synthesis of the various and complex facets of the meaning and use of the unities in English drama. Jonson repeated some of the basic assertions of the Italian Horatian-Aristotelian critics, used the terms and principles of the Terentian commentators, and wrote plays of unified and varied action and of limited representation of time and place. With Jonson the principles, but not the narrowly defined rules of the unities survived in English drama at the beginning of the seventeenth century.

With the concepts of the unities go several key problems that this study attempts to assimilate in its examination of critics and dramatists: the purpose of drama as an imitation of action; the meanings of verisimilitude and poetic truth; the Renaissance interpretation of imitation of the classics; the relation of double or multiple action and of variety of action to unity of action; staging conditions; the function of the chorus; the varying interpretations of just how unity of time and unity of place were to be defined. This study does not presume to clarify all these concepts and to exhaust all their interpretations. However, by way of conclusion, it can be said that Ben Jonson remained true to classical traditions of the purposes of drama; that he rejected verisimilitude in one of its meanings, the illusion of photographic reality on the stage; that he incorporated multiple action in his understanding of unity of action; that he accepted the principle of limitation of time and place, but not strictly defined rules; that he generally managed to apply the principles of the unities flexibly and advantageously.

Microfilm \$4.20; Xerox \$14.20. 328 pages.

THE LITERARY REPUTATION OF APHRA BEHN

(L. C. Card No. Mic 59-2274)

Ruthe Turner Sheffey, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Maurice Johnson

The purpose of this dissertation is to trace decade by decade the estimation in which the works of Aphra Behn were held. In addition, I attempt to indicate the political, social, and literary influences which have played a part in the assessment of Mrs. Behn's achievement. I discuss the critical reception of Mrs. Behn's works among her contemporaries at length in order to illumine some of the problems of seventeenth century drama and fiction criticism.

I include statements and allusions from memoirs, diaries, letters, newspaper accounts, poetry, and fiction as evidence of Mrs. Behn's reputation. Because of the paucity of direct critical reference in the seventeenth century, I consider the evidence found in Mrs. Behn's prefaces, dedications, postscripts, prologues, and epilogues. An account of the various editions through which these works passed, along with information on performances of the plays and their critical reception, is included. Finally, evidence of translations of Mrs. Behn's works into French, German, and into Russian, in one instance, is cited.

When a particular writer's judgment is heavily dependent on his social milieu or on his religious or political convictions, I indicate these kinships or antipathies. Moreover, I attempt to avoid violating the meaning of the context from which a criticism is taken. Similarly, the comparative worth of a critical estimate is preserved often by noting the writer's opinion of a rival writer in the same genre.

In the 1671-90 period, Mrs. Behn's works enjoyed a considerable popularity, evidenced in the statements in the prefaces expressing satisfaction with the high receipts from the plays, the regularity with which these plays were presented at court, and the frequency of the appearance of new editions. Although popular favorites like *The Rover* and *The Emperor of the Moon* continued to be acted in the 1690-1749 period and new editions of the works continued to appear, the new emphasis on morality in art revealed a shift in tolerance that soon operated to totally discredit Mrs. Behn. Condemnation of Aphra Behn by the literary giants Pope, Steele, Fielding, and Johnson was largely responsible for Mrs. Behn's waning reputation in the late eighteenth century. The nineteenth century reacted to the name of Aphra Behn with pious disgust, at least one writer admitting, at the end of a stream of critical invective, that he had not read Mrs. Behn's works. The view was gaining ground, however, that as a novelist Mrs. Behn was historically important and that as a song-writer she was superior to most of her contemporaries. After Montague Summers' edition of the *Works* in 1915, contributors to scholarly journals began to expatiate on Mrs. Behn's abilities as a satirist, a humanitarian, and a literary artist. A more important current development, however, is that the critics are objectively reevaluating Aphra Behn's works and are becoming increasingly aware of the seminal importance of her many-faceted career.

Microfilm \$2.75; Xerox \$9.40. 210 pages.

THE ENGLISH REPUTATION OF
MATTHEW ARNOLD, 1840-1877

(L. C. Card No. Mic 59-2065)

Charles Thompson Wilkins, Ph.D.
University of Illinois, 1959

The chronological study of Matthew Arnold's English reputation between 1840-1877 reveals a steady development in the contemporary recognition of his importance as poet, educator, and literary, social, political, and religious--in short as a general--critic. Significantly, Arnold's acute concern with the effects his works, whether poetry or prose, produced on his contemporaries and the important part his reaction to his critics had in determining the direction, manner and matter of certain of his major works becomes evident.

Arnold wanted to be read, and his stylistic method, particularly in his social and theological criticisms, was calculated to persuade and to provoke response. Thus fully to appreciate many of Arnold's allusions and the course of development of the essays, it is necessary to know precisely what the critical reaction was or had been to his work. Such works as *Culture and Anarchy*, *St. Paul and Protestantism*, *Literature and Dogma*, *God and the Bible*, and *Last Essays on Church and Religion* bear a direct relationship to the critical response to particular essays that Arnold had previously published in periodicals and to Arnold's practice of publishing an essay or a book, examining its criticism, and, if need be, answering that critical response in another essay or preface.

The first concern of this study has been to discover what Arnold's contemporaries actually thought of him and his work as revealed in primary sources and not to study in detail the actual use Arnold made of the criticisms of his literary efforts, but criticism that Arnold alludes to either in his correspondence or in his formal work has been indicated as far as possible. One result of this investigation is a bibliography of Arnoldiana far more extensive than any before available. A particular contribution of the bibliography is a substantial number of reviews and criticisms from some fourteen contemporary newspapers.

As a whole, the criticism of Arnold's varied literary endeavors discloses that no one of his works failed to receive adequate, respectful, and provocative attention. The very controversial nature of his work, and much of it, including certain of his poems, was by design reformatory and hence controversial, precluded anything resembling uniformity of judgments. The very diverseness of the evaluations indicates the multifaceted nature of the appeal of his poetry and essays. Yet there was a steady acceptance of Arnold as a significantly influential writer and thinker whose works demanded careful, often detailed, appraisal. Certainly Arnold was not considered by his contemporaries as a popular writer, but neither was he ever unpopular. Even when Arnold's work was the subject of rigorous attack, the critics generally manifested a respect for the man and his work that testified to their recognition of the selflessness of his aims, the pertinancy of his thought, and the facility and courage with which he advanced his ideas.

By 1877 Matthew Arnold was a major poet of his day; as a literary critic he was both a model and a seminal force; as an educator he was an authority whose contributions were considered germane even by those who opposed

him philosophically and politically; as a social critic he had performed the beneficent service of bedeviling English pragmatic self-complacency; and as a liberal thinker on religion and theology he was recognized as the proponent of a salient intellectual attitude of the time, albeit one unacceptable to the orthodox. In 1877, having completed most of his major works, Matthew Arnold was rivaled by few, if any, of his contemporaries in the distinction he had achieved as a poet and as a literary and general critic.

Microfilm \$6.50; Xerox \$22.60. 511 pages.

THE COMIC IMAGINATION OF THE YOUNG DICKENS

(L. C. Card No. Mic 59-2214)

James Arlington Wright, Ph.D.
University of Washington, 1959

Chairman: Wayne Burns

In this critical study of the early novels of Dickens, I seek to clarify the term "imagination" by calling critical tradition to my aid and then proceeding from it to my own contribution. From each of three important critics I choose one term that is important in describing Dickens. Taine speaks of hallucination; Bagehot, irregularity; and Van Ghent, demonism. To these, I add a fourth: precision. Energy of imagination does not preclude precision. In each chapter I seek to analyze a scene in which a feature of imagination can be revealed at work.

The argument concerning Pickwick shows how the imagination can fuse characters with their environments. Then I analyze the trial scene (Chapter XXXIII), in order to show how Dickens uses his imaginative creation in order to develop his theme: "the insolence of office." I conclude that the trial scene allows Dickens to use his imagination as protagonist of a farce. Farce is conceived as a strategy of resisting oppression by obeying rules instead of breaking them. Sam Weller is a sane man in an insane situation; and he attacks it by parodying it.

Oliver Twist and Barnaby Rudge deal with the nature of official violence. A child and a madman, respectively, are instruments of imagination. In Oliver Twist, Dickens displays his gift for seeing the world with "the absorbing eye" of childhood. In Barnaby Rudge, he sees the world through the eye of the madman Barnaby, to whom the hangman Dennis is identified both with Newgate Prison and with the insane mob who destroy it.

In Chapter V I try to show how the imagination works best when Dickens is free from preconceptions, both structural and thematic. Dickens carefully planned the "message" of Nickleby, but it fails because he is not able to develop the daydream of melodrama beyond itself. But in The Old Curiosity Shop, the circumstances of the novel's origin liberated the imagination from the inhibition that choked Nickleby. When sales slackened, Dickens was forced to improvise, and improvisation is his greatest self-liberating device. He can relate Quilp the villain freely to other parts of his novel, as he had failed to do with Squeers.

The free accumulation of diverse materials is also a factor in the greatness of Chuzzlewit. Here I study the

relation between the "plot"--including its "moral framework"--and the imagination. I see the book as the occasion for a struggle between plot and imagination. Again, I examine the circumstances of the book's origin. Forced to violate his first plan by sending his hero to America, Dickens creates a new, truly imaginative design. Thus, while his involvement in middle-class sanctimoniousness and the artistic inadequacy of his "plot" are both acknowledged, it is nevertheless argued that his violation of these two aspects of his fiction is not equivalent to violation of coherent fictional art.

Since Dickens' exploration of "social tyranny" in Chuzzlewit marks the first major appearance of his despair over the failure of middle-class society to respect the sanctity of individual human beings, this novel provides a convenient conclusion to the study. For Dickens' tone changes thereafter. Of course, he wrote for money, and so the legless heroines and arch heroes are to return. But the essential joy of the early period is over.

Microfilm \$4.05; Xerox \$13.80. 317 pages.

LANGUAGE AND LITERATURE, LINGUISTICS

TRANSFORMATIONS OF POLISH

(L. C. Card No. Mic 58-3308)

Casimir Borkowski, Ph.D.
University of Pennsylvania, 1958

Supervisor: Zellig S. Harris

The linguistic transformations of Polish are listed and described. Linguistic transformations are defined as an equivalence relationship between sentences or constituents of sentences. We say that two or more linguistic constructions are satisfied by the same n-tuples of members of their constituents. Such constructions are said to be in a transformational relationship, and each can be derived from the other(s) by a particular transformation.

Different methods have been used in this investigation to determine whether two or more constructions which contain the same constituents are indeed transformations of one another. The method most frequently used was to postulate two or more constructions as transforms of one another. An attempt was made to disprove this assumption by testing whether all the co-occurrences of one construction are in fact the co-occurrences of the other.

A list of basic Polish sentences was set up in such a way that all other sentences of Polish will be transforms of this basic set of sentences. This provisional set of kernel sentences will be the subject of further investigation. The following transformations between sentences and constituents of sentences have been determined.

The following transformations were found:

- (1) Word-order transformations, (2) Assertion-Interrogation transformations, (3) Negative transformations, (4) Mass noun transformations, (5) Active-Passive transformations, (6) Imperative and Vocative transformations, (7) Transformations between sentences and infinitive

constructions, (8) Nominalization transformations, and (9) Sentence conjoining transformations.

Microfilm \$2.00; Xerox \$4.00. 72 pages.

LANGUAGE AND LITERATURE, MODERN

THE PUBLISHED COMEDIES OF JUAN PÉREZ DE TOLEDO

(L. C. Card No. Mic 59-2005)

Elizabeth Sterrett Bibb, Ph.D.
University of Illinois, 1959

Juan Pérez de Toledo (Joannes Petreius Toletanus) was born between September 1512 and August 1513, presumably at Toledo, Spain, and died in 1545. Biographical data concerning him is limited, but we know that he was a precocious student and, while yet a young man, became a professor in the then new Spanish University of Alcalá de Henares.

His works, all in Latin, include a textbook of rhetoric, *Progymnasmata artis rhetoricae*, the only book published during his lifetime, a long religious poem, *Libri quattuor in laudem divae Mariae Magdaleneae*, published with a collection of epigrams which give us most of what little personal information we have about Pérez, the manuscript of a play, *Ate relegata et Minerva restituta*, and the four comedies with which this dissertation is concerned.

The latter are *Necromanticus*, *Lena*, *Decepti*, and *Suppositi*, and were published posthumously by the author's brother in 1574. Written for performance by students, all are adaptations of Italian comedies. The *Decepti* is taken from an anonymous work, *Gl'Ingannati*, and the others are from plays by Ariosto.

A careful study of the Latin text reveals that Pérez usually translated the Italian models freely in a simple Humanistic Latin style, without significantly altering the meaning. Some passages are almost verbatim translations of the Italian; others are adaptations which preserve the general sense without slavish reproduction of details. Pérez simplified and shortened particularly long or complex speeches, suppressed many purely local and contemporary references, and omitted parts which he considered improper. The latter include all references to Jews, and all derogatory or satirical mention of Spain and the Catholic Church. In such cases, he either deleted the passage, if it was unimportant to the plot, or substituted something innocuous. The *Decepti* is the play which differs most markedly from its Italian model. Here, Pérez has omitted an entire subplot containing objectionable references to Spain and religion. No such striking differences occur between Ariosto's plays and Pérez' adaptations, indicating that the Spaniard probably hesitated to make many changes in the works of the Italian master. Plots and characters of the latter are almost identical, with the omission of only a few minor figures and incidents. As to Pérez' treatment of such features as proper names, he in some cases Latinized the Italian names, but more frequently he substituted a Latin or Greek personal name for one that was distinctively Italian. The religious references, after the elimination of everything that Pérez thought irreverent or impious,

are almost always translated in the polytheistic vocabulary of ancient Latin. The things and conventions of daily life are described in a vocabulary that is almost entirely ancient, but Pérez made no attempt to transport the scene from contemporary Italy to the ancient world. As a result, therefore, Pérez' Latin adaptations, like many other Humanistic comedies dealing with contemporary characters and situations, have a setting which belongs to no historical era, and seem to take place in a timeless world in which men, for example, swear by Hercules but fight the Turks.

Microfilm \$3.25; Xerox \$11.20. 251 pages.

ANTI-AUTHORITARIANISM IN THE WORKS OF JAMES JOYCE

(L. C. Card No. Mic 59-2197)

Helmut W. Bonheim, Ph.D.
University of Washington, 1959

Chairman: James Hall

One of the central themes running through Joyce's work from beginning to end is that of man versus power. Anti-authoritarianism is primarily a technique, a pose on Joyce's part, rather than a reflection of his deepest beliefs. Yet this pose exerts a considerable effect on Joyce's material and on his way of presenting it. The anti-pose is a significant dimension of *Dubliners*, of *A Portrait of the Artist as a Young Man*, and of the play, *Exiles*. In *Ulysses* it is the very failure of Bloom as authoritarian, as husband, as man, as advertising canvasser, that makes it possible for Stephen to accept him at all. And it is largely in its ceremonial aspects that Joyce finds the church and the nation even partially palatable. The conflict between individual will, repeatedly symbolized by an *o* in the book, and the force of an oppressive society, symbolized by an *s* ("Society with a big S"), is resolved in the puns on their fusion, *os*, the Latin for *bone*, a key word in Bloom's vocabulary.

In *Finnegans Wake* anti-authoritarianism again exerts its selective force, especially in the castigation of fathers and father-surrogates. King Mark, for instance, appears over 125 times in some most uncomplimentary form, whereas the young lovers, Tristan and Isolde, are dealt with quite gently. In the same way, the epithets for God the father are most insulting, whereas Christ and the Buddha, also religious but not authoritarian figures, appear in practically unvillified state. Kings, generals, senators and other figures of authority are thoroughly insulted. At various points in the book we find traces of a more comprehensive theory of anarchic disobedience, and several cautions from Joyce that we may read apparently innocent and personal drama as politically significant allegory. Were *Finnegans Wake* a book with a singly message, which it is not, that message might well be: Man must learn to disobey.

Microfilm \$2.55; Xerox \$8.80. 195 pages.

THOMAS WENTWORTH HIGGINSON:
REFORMER AND MAN OF LETTERS

(L. C. Card No. Mic 59-1322)

Sister Thomas Catherine Brennan, O.P., Ph.D.
Michigan State University, 1958

Supervisor: Claude M. Newlin

This thesis is limited to Thomas Wentworth Higginson's career as a man of letters and as a reformer in the anti-slavery and woman suffrage movements. Divided into five chapters with a preface and bibliography, the study includes Higginson's political views, his anti-slavery activities, his service in the Civil War, his woman suffrage activities, and his writings on these subjects.

Chapter I, the "Introduction" indicates the approach used in this study by stressing the integral relationship which existed between Higginson's life as a reformer and his life as a man of letters.

Chapter II, "The Minister and the Slaves," discusses Higginson's political views as a Republican and as an ardent abolitionist, his anti-slavery activities connected with the fugitive slave rescues, the Kansas emigration, the John Brown affair, and his liberal views as expressed in speeches and sermons published in the *Liberator*. The chapter concludes with Higginson's change of heart toward disunion after the secession of the south and the attack on Fort Sumter.

Chapter III, "The Soldier and His Regiment," recounts Higginson's military career as colonel of a regiment of Negro freed men in South Carolina. His Civil War memoir, *Army Life in a Black Regiment* depicts his impressions of the Negroes and his opinion of the status of the freed slaves. This book and his work as State historian of Massachusetts, together with several essays related to this period are the subject of this chapter.

Chapter IV, "The Colonel and the Ladies," describes Higginson's activities at woman suffrage conventions, his social theory of American democracy as expressed in the women's magazines, *Woman's Journal* and *Harper's Bazar*, his literary criticism of the new school of local color writers among whom were several woman, his assistance as literary advisor of Harriet Prescott, Helen Hunt Jackson, and Emily Dickinson, his biographies of Lydia Maria Child, Una Hawthorne, Margaret Fuller, and Julia Ward Howe. His fiction, *Malbone* and a few short stories, portray feminine types, and his essays for the *Atlantic Monthly* set up an ideal of womanhood and suggestions for reform in dress and the health habits of women.

Investigation of these phases of Higginson's career has borne out the reputation he holds as a writer of high literary quality and as a reformer of high romantic idealism.

Microfilm \$3.95; Xerox \$13.20. 305 pages.

THE WORLD OF VIRGINIA WOOLF:
A STUDY OF HER VIEW OF REALITY

(L. C. Card No. Mic 59-1810)

Robert Curtis Brown, Ph.D.
Rutgers University, 1959

This study is an attempt to define Virginia Woolf's view of reality through an analysis of her novels, short stories, and critical essays.

Chapter I contains a discussion of Mrs. Woolf's life, a consideration of both her ancestors and the external facts of her life in order to understand her art.

Chapter II offers an analysis of the early writing of Mrs. Woolf, *The Voyage Out*, *Night and Day*, and *Monday or Tuesday*. In these three works, we have three views of reality. The first view is centered in the private, solitary sensibility of Rachel Vinrace, the heroine of *The Voyage Out*, who can find no method by which she can order into coherence the moods, impressions, sensations, and attitudes which shower down upon her. The second view (*Night and Day*) stresses the value of the social world rather than the private world, a social world in which it is possible for one to retain his individuality and at the same time find compatibility through close association with other human beings. The third view (*Monday or Tuesday*) suggests, since relations between human beings are so tenuous, that one might well shift perspective from people to things and, in a sense, begin life anew.

Chapter III considers *Jacob's Room* and *Mrs. Dalloway*. The former novel, a collection of moments in the life of Jacob Flanders, dramatizes the hero's inability to order into synthesis his impressions, and it stresses Mrs. Woolf's persistent theme of the unknowableness of people. The latter novel is an exposition of dominant rationalisms (the desire to live) and irrationalisms (the desire for death), and the issue of Clarissa's experience of these is her discovery of herself. Life, as Clarissa finally views it, becomes a matter of existing for one's self.

Chapter IV considers *To the Lighthouse*, *Orlando* and *The Waves*. *To the Lighthouse* offers the notion that intuition is preferable to intellect in grasping reality. The unknowableness of people is contrasted with the proposition that one may gain a clearer insight into reality if he were to return to a consideration of natural forces. Finally, the novel stresses Mrs. Woolf's belief in the power of the moment, which suggests that the various and conflicting impressions cannot be understood by an individual except in the intensity of a momentary vision. *Orlando* offers statements on the force of time (mental time as opposed to calendar time), the presumed superiority of men, and the similarities and differences between the sexes. *The Waves* traces the lives of six sharply defined characters who, in private monologues, undergo a quest for self-knowledge and self-command.

Chapter V considers *The Years* and *Between the Acts*. *The Years*, a novel made up of moments during fifty years, is important because it is the only novel in which Mrs. Woolf wrote directly of social problems. In addition it stresses the power of momentary vision and the notion that the relationship between two people might save society. *Between the Acts* contrasts England's past glory with its present day disintegration. It stresses the power of intuition as opposed to reason, and it suggest that love, together

with faith in human beings, might act as a stabilizing force in the ceaseless flow of life.

We have, in the world of Virginia Woolf, a desperate search for values which led her on the one hand to assert that stability might be possible in an exalted moment of vision, and on the other hand, to despair of stability and to shift perspective away from people toward things. When we have read her works, we realize that she has explored areas of human experience which led her to formulate a world filled with terror, loneliness, where no certainty is possible save in the power of momentary vision.

Microfilm \$2.20; Xerox \$7.60. 165 pages.

LA CREATION ROMANESQUE CHEZ MALRAUX

(L. C. Card No. Mic 59-2350)

Jean René Carduner, Ph.D.
University of Minnesota, 1959

A. Malraux is one of the most influential living French writers. To many, he typifies the brilliant French intellectual, capable of action and thought. As such, he has been studied at some length. But critics have overlooked the fact that Malraux's importance is due primarily not to his legend, nor to his life, nor to his political attitudes, but to his novels. Any attempt to evaluate Malraux's place in French literature must then be based on appreciation of him as a novelist. It is the object of this thesis to study Malraux's accomplishment as an artist.

As we have to deal with a living writer, an exhaustive study is impossible. The only possible method is to investigate his novels with the help of his other writings, especially his art criticism. Our approach is external.

The study of the point of view reveals Malraux's basic attitude toward his material: he is unable to be objective, that is to say, he always writes a story from the point of view of the different characters who participate in the action and know only what they see. As a result the reader too shares this point of view; he feels deeply committed to the action, living it, not watching it.

This "dramatic" conception of the novels is confirmed by an analysis of their structure. "Scenes" are the basic building blocks. For this reason, composition is paramount: a novel cannot be a mere succession of dramatic units. This explains why the structure of Malraux's novels is always extremely solid. Not only is the general pattern of the book clear and meaningful (the tragic pattern of *Man's Fate* is the best example), but the connection between each unit of the same type as well as the counterpoint between dramatic scenes and scenes of dialogue are so carefully achieved that they give a unity of its own to the whole novel.

Malraux's technique appears as very much influenced by the motion picture technique, and this becomes even more striking if we examine the organization of each unit. Each scene is a succession of shots (close-up, long shots etc. . .) whose editing is of utmost importance because eventually, their succession reveals Malraux's whole view of the world: a view of heroes lost in an hostile environment between the indifferent serenity of the cosmos and the implacable suffering of death.

A study of characterization completes this scrutiny of Malraux's technique. The weak point of his novels is

certainly this: none of his characters really reaches the autonomy of a personal life in the way the great heroes of fiction do. But we must stress that this absence of "real" characters, far from being specific of Malraux, has been a general feature of the novel since Proust.

We must judge Malraux's novels for what they are. They do not fit Balzac's requirements. But Balzac, great novelist as he was, is not THE novelist. Malraux's best works: *Man's Fate* and *Man's Hope* meet the necessary and sufficient requirement of all novels and works of art: they create a world of their own which is a reflection of the world we live in. This reflection is faithful enough to permit immediate identification (this accounts for its impact on readers) and imaginative enough to transform its own nature, to enter the eternity of the world of art.

[This thesis written in French.]

Microfilm \$3.45; Xerox \$11.60. 265 pages.

THE TECHNIQUE OF GRAHAM GREENE: A STYLISTIC ANALYSIS OF FIVE NOVELS

(L. C. Card No. Mic 59-1674)

Dominick Peter Consolo, Ph.D.
State University of Iowa, 1959

Chairman: Professor Clark Griffith

The emphasis in this study is on Graham Greene's technique in five of his novels: *Brighton Rock*, *The Power and the Glory*, *The Heart of the Matter*, *The End of the Affair*, and *The Quiet American*. Technique will be taken here in its larger sense to mean: "any selection, structure, or distortion, any form or rhythm imposed upon the world of action." Specifically, this study focusses on the structure, point of view, image and symbol, language and in so far as it informs a particular approach by Greene to his fictional world, character. Consideration of predominant themes in the novels under discussion, since these have been emphasized in the main by other critics, are less important to this study, although there is no intent to omit them entirely. For technique is not a mechanical affair, something external, but a primary operation that is at once the container and the thing contained.

Asserting what he likes to call the author's prerogative, Greene interweaves his own editorial comments smoothly into the novels by a skillful handling of point of view. Fore-shortening is achieved through the use of the catalogue, enabling him to maintain pace and inform character without impeding the action. Image and symbol create atmosphere and objectify emotions. Along with these, repetition of various verbal patterns sets up a rhythm which unifies narrative and theme through its recurrence.

This study of Greene's novels, then, is an attempt to show that his style is an integral part of the aesthetic pattern and incorporates the meaning and the action. It is not a mere observation car, a transparent vehicle whose only function is to carry the reader through a fictional world.

Microfilm \$2.10; Xerox \$7.40. 160 pages.

A CRITICAL AND HISTORICAL STUDY OF ZOLA'S
LA BÊTE HUMAINE

(L. C. Card No. Mic 59-2243)

Martin Kanés, Ph.D.

University of Pennsylvania, 1959

Supervisor: Carlos Lynes, Jr.

The present study investigates the writing of *La Bête humaine* from the earliest references to the appearance of the book, and is based upon methods first outlined by Pierre Audiat in his *Biographie de l'oeuvre littéraire*. The specific problem was to analyse Zola's methods of composition with a view toward throwing light upon his techniques and works in general.

The material now in the Bibliothèque Nationale (consisting of preliminary notes and sketches as well as the manuscript itself) was studied and arranged in chronological order as far as possible. A clear-cut division resulted. One group of notes, containing about 500 folios, can be called truly "creative". The second group of about 175 folios contains purely documentary material. The establishment of the chronology showed that Zola began work very slowly (writing less than 60 pages from about August 1888 to February 1889). On the other hand, he appears to have drawn up over 600 folios from February to May 1889.

It became clear from the study that documentation far exceeded the needs of the novel, and represented a means of self-assurance. The sense of security thus conveyed was more important than the information itself.

The "creative" notes record the process of composition that paralleled documentation. The incidents of the plot stem partly from the documentation and partly from events in Zola's life in 1888 and 1889. In manipulating his material, Zola obeyed certain deeply seated obsessions most of which had distinct sexual overtones. These obsessions were so domineering that they were translated into specific verbal formulae which are repeated throughout the notes.

By collecting all available material pertaining to the composition and publication of *La Bête humaine*, by analysing the preliminary material, the manuscript, the feuilleton and the first printed edition, this study attempts to contribute not only toward a deeper understanding of Zola's methods, but to make an indispensable step toward the preparation of a much needed critical edition of his works.

Microfilm \$3.20; Xerox \$11.00. 246 pages.

THE IMITATION OF WAR 1800-1900:
REALISM IN THE AMERICAN WAR NOVEL

(L. C. Card No. Mic 59-2448)

Marvin Klotz, Ph.D.

New York University, 1959

Adviser: William M. Gibson

Literary realism has been employed as a critical term without proper discrimination. As a result the term has lost much of its critical significance. Analysis of a cross-section of nineteenth century American war fiction from Cooper to Crane reveals that specific criteria for realism

can be developed in terms of attitude, plot, there, characterization, and rhetoric.

The attitude toward war revealed in the early historical war romance differs from that revealed in the novels of "realistic" writers. Cooper and his contemporaries employed the condition of war as an opportunity for men to attain glory, and as a result, few of the sombre aspects of war appear in their work. This romance tradition continues to the end of the century embodied in the work of writers like John Esten Cooke, Thomas Nelson Page, S. Weir Mitchell and Paul L. Ford. John W. DeForest, by revealing the inglorious aspects of war in his novel *Miss Ravenel's Conversion from Secession to Loyalty* (1867), introduced new attitudes which informed the work of authors like Joseph Kirkland, Harold Frederic, and Stephen Crane.

The plots of the nineteenth century romance from Cooper to Mitchell are all based on a love-interest and culminate, with only occasional exceptions, in the wedding of the hero and the heroine. War is an obstacle to the final happiness of the central figures and frequently provides a villain from among the enemy to threaten them. Both war and villains are invariably overcome. Few nineteenth century war novels reveal truly "realistic" plots, which should give the illusion of randomness, and only Crane, of the "realistic" war writers, plots a novel with neither hero-villain relationships nor love-interest.

The romance reflects the pre-Civil War view of human nature in America and thus consistently incorporates the theme of poetic justice. The post-Civil War view of human nature, which did not insist on man's rationality, allowed for new themes some of which, by design, revealed the absence of poetic justice. Furthermore, the later fiction tended to introduce vigorous social criticism. In the romances which occasionally employed such criticism the evil-doer is punished; in realistic fiction, the evil-doer frequently goes free.

Characterization in the early romance reflected the concept of the gentleman in America, much as fictional themes reflected the concept of human nature. Only gentlemen and ladies appear in romance and the "fine" gentleman is frequently the villain. These characters do not develop. In realistic fiction, on the other hand, characters from the lower classes without the saving grace of natural gentility, are employed. Furthermore, characters develop in realistic fiction. They are altered by events which serve only to affirm character in romance.

Rhetoric in the romance is largely unimpressionistic with a low density of metaphor, and only scant imagery. Detail is presented objectively. In realistic fiction rhetoric is impressionistic with a high density of metaphor and much imagery. Detail is presented from a viewpoint, hence subjectively.

Thus realistic war fiction incorporates a sombre view of war, plays down love-interest and hero-villain relationships in a plot which avoids contrivance and neat convergence, and rejects poetic justice for more meaningful themes based on the post-Darwinian view of human nature. It introduces characters who change during the action, and it employs impressionistic rhetoric.

Microfilm \$4.05; Xerox \$13.60. 314 pages.

EDMUND GOSSE: A LITERARY RECORD

(L. C. Card No. Mic 59-1819)

Paul F. Mattheisen, Ph.D.
Rutgers University, 1959

Major Professor: Leslie A. Marchand

Although Edmund Gosse is chiefly remembered today as the author of Father and Son, he was one of the most popular writers in England during his lifetime. His rise to fame was incredibly rapid. In 1872 he was only a promising poet; by 1889 he was an established critic, scholar, biographer, poet and literary historian. He retained his fame for nearly sixty years, acquiring his greatest popularity during the final ten years of his life; yet his reputation was suddenly eclipsed after his death in 1928. The purpose of this study is to trace Gosse's career and to determine the characteristics of his work which appealed to three generations of readers but which made him anathema to the next. Two primary sources have been used. The critical articles and reviews by his contemporaries both elucidate Gosse's career and provide a partial record of literary movements between 1870 and 1928. Letters from his eminent friends often contain detailed criticisms of his work that serve as correctives to the opinions of prejudiced reviewers. Letters and reviews by well-known writers have also an independent interest.

Gosse began his career as a poet; but although he was always recognized as technically proficient, his early promise was never completely fulfilled. He fared better with his literary histories; two of them remained standard texts for many years. They were praised for their lively portraiture and epigrammatic conciseness, but they were often criticized for inaccuracy. One of them elicited the famous attack by John Churton Collins, who found many errors and manufactured others by deliberately forcing misconstructions on Gosse's words. Collins' venom was justly attributed to jealousy, but his attack was admittedly justified by the errors in Gosse's book.

Gosse's scholarly biographies culminated in the Life of Donne (1899), which repaired his reputation as a scholar, but which contained many misreadings of the poetry. The Life of Swinburne (1917) suffered from restrictions imposed on the use of materials and was criticized as a latter-day Victorian attempt at purification. Gosse's biographical monographs of lesser figures were more successful; the Lives of Taylor, Patmore, and Browne (1904-5) brought his reputation to its highest point until Father and Son appeared in 1907.

The best of Gosse's critical-biographical works were the short sketches known as "critical kit-kats," in which the subject's personality and literary works were used to illuminate each other. Gosse developed his technique early, in sketches by which he introduced to England several Scandinavian writers and helped to encourage the study of seventeenth-century English writers. In 1879 R. L. Stevenson urged him to know as many writers as possible and to "write a book about them"; later, George Moore encouraged him to emphasize the personality rather than the literature. Thus his best sketches were those of writers he had known; they were praised for vividness and fidelity and for momentary critical insight, but they were often found lacking in psychological depth.

Elements of the kit-kat persisted in all of Gosse's most

successful works. His weekly reviews in the Sunday Times during his last years took the form of attenuated kit-kats, in which he used his wide literary experience of fifty years; they brought him unequivocal fame as a man of letters because of their erudition, balanced judgments, and slightly malicious wit. But they were in themselves too slight to endure; and when Gosse died in 1928 his reputation declined as rapidly as it had risen. Interest in Gosse is reviving slightly; soon he may be more frequently credited for his pioneer work in seventeenth-century literature and for his picturesque sketches of his contemporaries.

Microfilm \$6.20; Xerox \$21.60. 487 pages.

EMERSON AND HIS AUDIENCE

(L. C. Card No. Mic 59-2250)

Robert Alan McGill, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Hennig Cohen

This study considers Emerson from the perspective of his experiences with his audiences as they contributed to the establishment of his career in the formative years from 1828 to 1847.

Emerson's audience actually functioned as three distinct audiences. There was first the audience actually collected before him, to whom he addressed his spoken words, predominately the lecture audiences. Here he set up his market place, validated his wares, discovered the public's taste, reflected on its needs, and delved for the essential truths of man in nature and society. It is this audience with which this study is primarily concerned: the central thesis of this paper is that Emerson flinched from it at the same time that he admired its vigor, acknowledged its judgment, and sought its Fame. Learning to confront it and serve it developed influential characteristics of his personality, his message, and his style. But, concurrently, there was also the reading audience. He gathered his first readers with his Nature as a preliminary to his second round of lectures, and after the unhappy aftermath of the Divinity School Address, he almost decided to rely wholly on it with the Essays. But this audience merely enhanced his influence, clarifying aims to make his contact with the listening audience more significant and serviceable. Then there was a third audience, the close friends whose encouragement buoyed him in the moments when his sense of failure with the public audiences depressed his ambitions and he decided almost to be an oracular poet. This intimate group's excessive demands on his emotions and personality provided an immediate audience for his poetry--but also forced him back to the public market as he found a more general poetic audience among his listeners and readers. Out of this process, the "Representative Men" series resolved the conflict and established his public character.

This portrait of Emerson emerges basically from a very close reading of the journals, letters, and publications of the period--from Emerson, from his contemporaries, and from the public press--set in the knowledge of his works, biography, and times. Its presentation is incremental. Relatively static conditions which generally obtain

for the whole period or exert strong influences throughout the period dominate the early chapters, while developing divergencies or specific crises or new experiments--which of course concern Emerson's actions and reactions primarily--occupy the attention of the later chapters and should be read within the framework established from the first chapter. The study first, in Chapter I, projects and defines its perspective and the general audience situation into which Emerson stepped. Chapter II then presents the concept of audience relationships he carried with him into the fray, and the general refinements time wrought upon it. After this preparation, Chapters III to V analyze the early audience-speaker situations as Emerson gathered his audience and recorded his first gains, in experience and followers. Each analysis thus builds upon the previous ones, as does the tracing in Chapter VI of the aftermath of the Divinity School address. This crisis is demonstrated to be the central turning point in his development as a writer and speaker. It led to the new experiments and wider audiences which are next analyzed in Chapters VII and VIII. And a study of the resolution of the issues it raised completes the period and the study with Chapters IX and X. Microfilm \$4.45; Xerox \$15.00. 347 pages.

POETIC IMAGES AND MOTIFS IN
CONRAD FERDINAND MEYER'S PROSE WORKS

(L. C. Card No. Mic 59-2490)

Walter Duff Morris, Ph.D.
The University of Texas, 1959

Supervisor: Professor Helmut Rehder

This dissertation seeks to obtain an understanding of Conrad Ferdinand Meyer's "poetic personality" through intensive study of the imagery which appears in his prose works. Significant repetitions of imagery are noted in order to discover the "complexes" around which Meyer's thought revolves. The author's total prose production reveals certain basic patterns of his imagery which involve empirical and aesthetic phenomena, as well as others involving compositional structure and metaphysical and moral motifs. By looking deeper into the usage of each image, the attempt is made to come to an understanding of Meyer's method of composition and to formulate a conclusion concerning his *Weltanschauung*.

Since Conrad Ferdinand Meyer is a writer whose work involves a wealth of imagery, this study is able to produce considerable evidence of the author's use of repetitive symbols. The method of procedure followed has been to examine each situation with regard to the question: "How does the concept of space, the particular mode of lighting, or the presence of certain objects in a given situation serve to intensify and explain Meyer's purpose?" The discussion demonstrates that the poetic imagery is often the very key for the understanding not only of the action immediately involved, but also of the whole *Novelle* under consideration and of the totality of Meyer's "poetic personality." The examination begins with an analysis of the spacial characteristics of the stages onto which Meyer projects the action of his *Novellen*; then it proceeds to an analysis of the mode of lighting he utilizes to achieve his

effects. The same procedure is applied to the use of individual objects whose images most fully convey Meyer's ideas to the reader. This inquiry investigates the function which his imagery possesses in the composition and structure of the *Novellen* themselves. Finally, from a survey of the motifs involving poetic imagery, the study moves towards an understanding of the metaphysical meaning of his motifs and towards a more complete understanding of his *Weltanschauung*.

Microfilm \$2.45; Xerox \$8.60. 186 pages.

A CRITICAL EDITION OF *LOVE TRICKS, OR
THE SCHOOL OF COMPLIMENT*,
BY JAMES SHIRLEY

(L. C. Card No. Mic 59-2258)

Nixon Mumper, Ph.D.
University of Pennsylvania, 1959

Supervisor: Matthew W. Black

The introductory material of this edition of James Shirley's *Love Tricks* contains a life of Shirley, a history of the production and publication of the play, an inquiry into the sources of the play, and a discussion of its realistic background in London life.

Since *Love Tricks* was Shirley's first play, and especially because he showed much knowledge of London life, his life up to the production of the play in 1625 has been more fully treated than has his subsequent career. A knowledge of the background of events in and about London in the early part of the seventeenth century is of value to a reader of the play, and for that reason extensive treatment has been made of the London background of Shirley's play. Since *Love Tricks* comments on London life of the 1620's, an effort has been made to find out why Shirley satirized newspapers and newspapermen, informers, monopolists, and persons who engaged in excessively courteous behaviour. For his satire of amorous verses, learned-sounding speeches, complimentary speaking, the tearing of a passion to tatters on the stage, Shirley found many examples in the London of his day.

The text of the present edition is based on the second edition, 1637, and has been collated with the first edition, 1631, and the third edition, 1667. The spelling, capitalization, and punctuation of the 1637 edition have been retained. All variants in punctuation and text have been recorded. Explanatory notes have been supplied to define or clarify words and phrases now obscure.

Microfilm \$4.10; Xerox \$13.80. 317 pages.

JOSEPH HERGESHEIMER: A CRITICAL STUDY

(L. C. Card No. Mic 59-2260)

James Joseph Napier, Ph.D.
University of Pennsylvania, 1959

Supervisor: Professor Edgar L. Potts

The work of Joseph Hergesheimer has been ignored by recent students of American literature. Yet there are two reasons why it should not be overlooked. The first is that his career has a definite historical interest. From obscurity in 1917 he rose within five years to the front rank among contemporary writers and was universally recognized as brilliant and promising. The second is that Hergesheimer's novels have a justifiable place in the literary history of American literature. Their content combined a deep bias of aestheticism (the term is used here to refer to the creation of beauty as basic in a work of literature, with all other qualities subserving the first) and a feeling for native American setting and subjects. But Hergesheimer's decline in the nineteen twenties leads to the following question: why, with such an impressive beginning, did he lose his power and influence? By taking as a key the writer's absorption in an aesthetic ideal derived from European and English sources and applied to American subjects, we can trace his development through his most representative novels in terms of his fundamental interest. The novels are The Lay Anthony, Mountain Blood, The Three Black Pennys, Java Head, Linda Condon, Cytherea, Balisand, Tampico, and The Limestone Tree. His other books, such as San Cristobal de la Habana, The Presbyterian Child, and From an Old House, together with his extensive correspondence and friendships, are also illuminating in regard to this subject. This study attempts to provide an understanding of how Hergesheimer reconciled a foreign literary ideal with his American interests, of the essential narrowness of this ideal, and of how his pursuit of it led him inevitably to a withdrawal from the life around him and the weakening of his art during the rapidly changing era of the late nineteen twenties and the early thirties. Microfilm \$3.95; Xerox \$13.40. 308 pages.

AMERICAN LITERATURE AND SOCIAL CRISIS,
1837-1842

(L. C. Card No. Mic 59-2307)

John William Nichol, Ph.D.
The Ohio State University, 1953

A phenomenon in the history of literature like that popularly known as the "American Renaissance" is certain to inspire conjectures as to its causes. Why did there happen to appear in America, in one concentrated moment of expression at the middle of the nineteenth century, a wealth of literary masterpieces such as has never been duplicated in any similar period? Emerson's Essays, Thoreau's Walden, Hawthorne's The Scarlet Letter and The House of Seven Gables, Melville's Moby Dick, Whitman's Leaves of Grass are but a few of the mid-century classics.

Many explanations have been advanced. However, be-

lieving that what a man thinks and writes is not entirely independent of the life he leads as a social and economic animal, I felt that there might be some general relation between the peculiar social conditions of the time and the extraordinary production. Since such a study had not yet been adequately made, it was along this line that my investigation began.

In the two decades preceding the outburst of literary productivity in the middle of the nineteenth century, the United States had a period of sharp social and economic change, recognized by historians as constituting a crisis in the development of the nation. The change was from the predominantly patrician culture of the beginning of the century to the democratic culture signaled by the rise of the common man. By 1837, after two terms of Jacksonian rule, the new political and social democratic enthusiasm was at its height. The year 1837 also marked the beginning of the worst panic the United States had yet experienced. Furthermore, in this year most of the writers who were to make up the Renaissance were in the process of developing the attitudes and philosophies which were to inform their later writings. Thus I chose this year and the five years of depression following it as the ideal period in which to concentrate a study of the relationship of a social crisis to the literary mind.

Two conclusions emerged from the study. First, although the idealistic writers favored the freedom and the high place promised the individual in the new ideal social order, it was evident that they were dissatisfied with the way in which democracy was actually being implemented, with the way in which the bourgeois and vulgar equalitarian social and economic standards were being forced upon even the artistic genius. Thus they were in conflict with their society, and the resulting tensions between the ideal and the actual were instrumental in bringing out much of the literary expression of the time. This was my first conclusion. The second followed almost directly, and involved the setting up of a relatively new critical position from which to view the mid-century writings themselves. Thus, in addition to studying these writings as examples of the new-found interest in romantic, democratic, liberal individualism (as they have usually been studied), one must always be aware of the minor but ever prevalent aristocratic, reactionary feeling, either begun or strengthened in these years of crisis, which contributed to the complexity of the finished products. From this viewpoint Hester, or Ahab, or even the American "scholar" becomes more fully understandable.

In order to make clear just what the conservative bias in the literary mind was reacting to, in the first part of the study I have reviewed the changes which were taking place to make the years 1837-1842 a period of social crisis, and have emphasized those portions to which a writer was most likely to react. Part of the change was social and economic in character. The population figures rose from 9,600,000 in 1820 to 17,000,000 in 1840, and with this growth came several other social changes. These years saw the movement to the West and the rise of manufacturing industries. Both of the latter phenomena in turn gave rise to new classes of people with new interests and enthusiasms—the Western settler and the farmer and the laborer. Out of this combination came the chief elements of the Jacksonian-Democratic Party, the nucleus around which all the new anti-patrician ideas were centered. It must be remembered, however, that it was not only the Jacksonian

party that was in favor of the changes. The Whigs too were engrossed in much of the spirit of the times and had accepted the expanding franchise and the development of industrialism. It is perhaps unfair therefore to ascribe all the new trends to "Jacksonian" democracy, although that is the name most commonly used.

Other advances and changes contributed to the social and economic crisis. Technological advances in transportation, communication, and agriculture, and the invention of new manufacturing processes and machines, all centering in these years, helped to make the common man more important and to change the whole tone of society in the United States. The expansion of material prosperity, though, led to a spirit of exaggerated speculation and materialism, and the whole period of change and movement was climaxed in the Panic of 1837. This slump was due not only to a speculative spirit but also to an inadequate financial structure, which, not being accustomed to the new industrial economy nor to the new animus against monopoly and money power, collapsed when overburdened. Since writers felt the effect of the depression as sharply as anyone, and since it was an essential part of the social environment to which the writers reacted, its causes and results are important to the study.

With the change in social and economic control came the change in the intellectual domination. The older patrician culture which had existed even up to 1828 and in which most of the authors of the time had their backgrounds was being replaced by the popular culture of the common man. Education was being made more universally available; new liberal religious trends were undermining the old clerical hierarchy. Equalitarian ideals in standards of manners, morals, and architecture reflected the increasing belief in "equal rights" and universal suffrage of democratic politics. Reform movements were at their height in this period of change, and new enthusiasms of nationalism and patriotism ("provincialisms," some of the writers called them) were abroad in the United States. The masses of the new country had awakened all at once to their own importance, and, in the view of many a cultivated person, had gone to excess in taking advantage of their position before they were yet ready or capable.

In the literary and publishing realm, where the writers were most in contact with their society, the changes were especially notable. Bookmaking improvements, the lack of international copyright law, pirating practices, and journalistic invasion into the realm of literature all combined to cause an exaggerated lowering of book prices. Thus, when the writers were hardest hit by the depression the greed of the cheap-literature-minded public and the corruption of the various publishing mediums—especially the new penny "news" papers—made it even more difficult to obtain a living through literature, unless the literature were shaped to fit the new and popular, oft-times shallow and vulgar, public taste. And there developed a "politico-literary system" of literary criticism calling itself "Young America," which was devoted to the encouragement of the new democratic literature. Believing all this to be at least partially the result of the contemporary expression of democracy, many of the writers were in reaction against their society.

The clearest and most overt expression of this reaction to the popular excesses and vulgarities was exhibited by three authors who were relatively sure of their contempt for the democratic society of the time: R. H. Dana, Sr.,

E. A. Poe, and J. F. Cooper. Dana was probably the most conservative of the three; the whole of his life and writings was one great protest against modern innovations, either political or social. He was ready to return to monarchy and class society as an antidote. Poe's attitude was somewhat more complicated. Not coming from an aristocratic background as Dana or Cooper did, he assumed a Southern aristocratic attitude which grew into a critical high-mindedness. This caused him to be vehemently opposed to the low standards—political, literary, personal—which he saw about him, but still he tried to make a living in the midst of the hodgepodge magazine world, and scrabbled along with the rest. He continued, however, to hold pathetically high standards, and his only answer was to look forward to some great day when his country would recognize and make a place for high genius. Cooper's attitude was the most complex of the three, and perhaps the most informative in our attempt to define the undercurrent of reaction in the writers of the Renaissance. Cooper loved democracy and had faith in it; he turned his genius in these years to writing open social criticism in order to make the democratic experiment work. But, like many others, he had his own idea of what democracy was and how much decorum and respect for the gentleman of worth should exist in a democracy. Thus he, too, was at odds with his society. Although at times his criticism and satire in books such as *The American Democrat* and *Home As Found*, written in 1838, might seem petty and personal, as if growing out of his own aristocratic temperament and background, they were actually the result of a deep underlying faith in the democratic idea.

Having established the point about the likelihood of a literary mind being in conflict with the developing American society in these years of crisis, I then selected, from among the authors of the American Renaissance, two who were both formulating their attitudes and already writing during the period: Emerson and Hawthorne. These I felt were authors in whom the more complex social tensions called forth, not social criticism alone, but some of their best creative and imaginative work. Emerson, coming from a long line of patrician clergymen, had managed to throw off a conservative inheritance, quit the ministry, and establish his own Transcendental philosophy of the divine worth of the individual man. But Emerson, as did the other writers we have seen, still retained an undercurrent of aristocratic bias, especially toward the popular equalitarian spirit of the day which scorned all evidences of individual worth and merit if it existed on a level not popularly understood. This bias was evident, in these years, in Emerson's reactions to society in general, to the faith in numbers and the majority, to the politics of the time, to the reform movements, and to the financial panic, but he still belonged to the "Movement Party" and believed in the principles of democracy. The resulting tensions, and the temporary answer he found in an aristocracy of worth—in the concept of the gentleman-scholar—inform practically all of the best work of his life.

Hawthorne, too, was drawn in two directions by his reactions to the democratic social emphasis in these years of change. In one paragraph he would criticize the new trends toward liberalism and equalitarianism in religion, manners, morals, architecture, reform, and literature, and in the next he would refute his earlier statement. Hawthorne's conflict lay in the fact that he believed "all that isolates damns, all that associates saves." but his own

underlying aristocratic feeling, his own tendency to champion the cause of individual worth and exceptional genius, as shown in much of his life and writing in these years, was a feeling or tendency which moved toward isolation, while the idea behind democracy itself moved toward association. Even the act of criticizing tended to isolate. Thus Hawthorne's problem, and its resulting tension, was as great as that of any writer of the Renaissance. There are indications, as I have pointed out, that his answer, too, lay not in a denial of democracy, but in an ideal democracy where each person was free, even from social pressure, to express his own individual integrity. But though this was his probable answer, the fact still remains, as developed in the study, that most of his imaginative work is colored by his reaction against the excesses of his society in this period.

These statements, conjectures, and conclusions I have attempted to document in the study. Emerson and Hawthorne were already writing during the years I have selected as a focus; some of the other mid-century group were not. But a critical position similar to the one I have arrived at is important to an understanding of the whole group of Renaissance writers who lived under and reacted to the same conditions of a raw, uncouth, leveling democratic society. Microfilm \$3.45; Xerox \$11.80. 266 pages.

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SOVIET CRITICISM OF THE WORKS OF FĖDOR DOSTOYEVSKY

(L. C. Card No. Mic 59-2207)

Temira Pachmuss, Ph.D.
University of Washington, 1959

Chairman: Victor Erlich

In the USSR Dostoyevsky's ideology has not, in general, been well received. The majority of Soviet critics find it very difficult to accept certain of the novelist's ideas, particularly his attitude toward authority and Russia's traditional institutions, his literary treatment of the theme of man's fundamental duality, and more especially his famous "cult of suffering." This study seeks to demonstrate the extent to which the works of Soviet critics reflect and give further development to objections to certain aspects of Dostoyevsky's ideology found in the criticism of the radical intelligentsia of the nineteenth century. It also seeks to investigate the fluctuations in the critical approach to the novelist, which closely reflect some of the most basic changes in literary policy in the Soviet Union.

The first chapter presents the historical setting of the "social" criticism of the nineteenth-century radical intelligentsia, with its appraisal of Dostoyevsky's alleged rejection of the many evils of anti-humanitarian and individualistic capitalistic society. The chapter also shows that Dostoyevsky's preaching of self-sacrifice, his fear of revolution, his "obscurantism," mysticism, and unwillingness to face the vital questions of the day were criticized and rejected.

The following chapter endeavors to show that during

the first decade after the October Revolution many widely divergent interpretations of Dostoyevsky's ideology were permitted within the Marxist approach to literature. The chapter also discusses the various approaches within Soviet criticism during that period.

The third chapter presents an evaluation of Dostoyevsky scholarship in the 1930's, when Soviet criticism was forced into conformity and all Marxist "deviationists" were suppressed. An ideological appraisal of Dostoyevsky's work, with special emphasis on "unmasking" his reactionary fallacies, became prevalent during this decade, and at the same time other critics attempted to adapt Dostoyevsky to the contemporary period. Relatively few works on the literary values of Dostoyevsky's art were published.

The Second World War led to Dostoyevsky's being elevated to the rank of a respected ally and a great Russian patriot. His writings were used to kindle contempt and hatred for the German invaders and to arouse Russian patriotic feelings. However, in 1946, with the advent of "Zhdanovism," the publication of objective, scholarly studies on Dostoyevsky came to an end. No argument in his support was now heard. The relaxation in the area of ideological interpretations was ended, and as a result, Dostoyevsky scholarship almost ceased to exist in Soviet Russia for six and half years.

By 1954, the paralysis of Dostoyevsky scholarship became a source of concern to the Soviet authorities. Consequently, scholars were invited, within limits, to analyze Dostoyevsky's art "objectively" and publish their findings. By 1956, this policy of "rehabilitation" and adaptation of Dostoyevsky was in full swing. The writer's negative attitude toward the capitalistic West was emphasized, and he was "cleansed" of alleged falsifications and distortions of human nature and of ideological illusions. His philosophy, which was nonetheless incompatible with canonized "Marxist-Leninist truth," was still severely criticized.

The conclusion of this study summarizes the development of Russian Marxist reaction to the writer, the process of establishing uniformity of thought in literary matters and of subordinating all intellectual and cultural activities to the interest of the Party, the shifting viewpoints in the critical writings under discussion, and their underlying ideological consistency.

Microfilm \$6.25; Xerox \$21.60. 490 pages.

HENRY JAMES: THE BLISS AND THE BALE

(L. C. Card No. Mic 59-1789)

Mary Ellen Parquet, Ph.D.
The University of Nebraska, 1959

Adviser: Dr. Walter F. Wright

It is the purpose of this thesis to examine the writings of Henry James in the light of the following quotation:

No themes are so human as those that reflect for us out of the confusion of life, the close connexion of bliss and bale, of the things that help with the things that hurt, so dangling before us forever that bright hard medal, of so strange an alloy, one face of which is somebody's right and ease and the other somebody's pain and wrong. (James's Preface to What Maisie Knew)

James is a realist who sees all of life as a mixture of good and evil. His understanding of the nature of reality as such a mixture underlies and informs his works. He uses each of his various major themes to throw further light on his basic philosophical position: the problem of accepting in human experience the "bliss and the bale," one person's right conjoined to another's wrong, appears in his tales dealing with the conflict between the past and the present; the problem of recognizing the necessary elements of incompleteness in life and in aesthetics lends moral significance to his tales of art and of artists; the impossibility of achieving a perfect relationship in marriage emerges as the dominant meaning in his works dealing with Anglo-American romance. Finally the inevitable close connexion of the things that help with the things that hurt is presented in a parabolic or symbolic way, in James's myths, allegories, and tales of the supernatural.

James's realistic approach to life accounts not only for his penetrating psychological studies of his characters but also for the choice of moral dilemmas in which he places his protagonists; for those who refuse to come to terms with reality, James sees a spiritual ruin, a total exclusion from the affairs of men. And yet he knows that the conflict of rights and duties which confront his men and women will often bring them to a spiritual victory only at the sacrifice of earthly and material happiness. The difficulty of recognizing the higher morality, the impossibility of separating the weal from the woe, often leads his characters to stark tragedy. But James believes that it is only by accepting the close connexion of the bliss and the bale that life may be experienced at all. He presents the rejection of the central paradox of man's moral life, the inevitable union of the good and the evil in every real situation and in every human personality, as a revolt against the very nature of human life itself.

Microfilm \$4.60; Xerox \$15.40. 360 pages.

AMBIVALENCE IN SHAKESPEARE'S HISTORIES: A RECONSIDERATION OF THE SECOND TETRALOGY

(L. C. Card No. Mic 59-2209)

Rodney Poisson, Ph.D.
University of Washington, 1959

Chairman: Arnold Stein

This dissertation begins by raising doubts about the uniformity of the climate of opinion against which certain scholars have interpreted the history plays. It points out, moreover, that the present emphasis upon these plays as history, in so far as it reduces them to expositions of current political dogma, not only overlooks the nature of drama in general and of these plays in particular, but leads to a basic misunderstanding. On the contrary, it is argued, a fully realized dramatic action by its very nature inclines towards exploration rather than exposition, dialectic rather than doctrine.

An analysis of the four plays from *Richard II* to *Henry V* suggests that Shakespeare is exploiting the dialectical nature of his form in a series of explorations of which the method is ironic and equivocal and in which the judgements are "qualified, relative, complex".

In *Richard II*, though the Tudor doctrines of divine right and passive obedience appear, the implications of the dramatic structure and of the language of the play look beneath to the sources of royal authority; and far from being a simple statement of orthodox sentiment, the play has a many-faceted quality that is demonstrably ambivalent. In *Henry IV* the alternation of themes is interpreted as a feature by which Shakespeare is exploring the pattern of betrayals. The function of Falstaff in this vision is now that of parodist, now that of ironic commentator. Emphasis on the righteousness of the royal cause is conspicuously absent, and sympathies are not partisan. Even in *Henry V*, notwithstanding the manifest epic intention expressed in the prologues, evidence of the equivocal mode is discernible -- though present to a lesser extent.

Thus seeming inconsistencies and opposed interpretations of these later histories are seen as features of an ambivalent drama that raises questions rather than makes statements. The thesis thus constitutes an argument for a shift in emphasis from that of established criticism.

Microfilm \$2.55; Xerox \$8.80. 195 pages.

THE VOGUE OF ROBERT LOUIS STEVENSON IN AMERICA, 1880-1900

(L. C. Card No. Mic 59-2314)

Roy Albert Riggs, Ph.D.
The Ohio State University, 1953

Robert Louis Stevenson began writing professionally in 1873, but he did not become an important figure on The American literary scene until the mid-eighties. Up to 1885, American reviews of his books tended to be favorable but routine and perfunctory. Except for one important article by H. C. Bunner in *Century Magazine* (February, 1883), there had been no careful critical analysis of his work. Periodical critics almost universally praised his style, his imagination, his humor, and his versatility, but they did not treat the appearance of a new Stevenson book as a major literary event. Each new book was well received; each added something to his slowly-growing reputation; but none caused any particular excitement among the critics; none created anything like a sensation with the public. There was a continuing tendency on the part of the critics to regard Stevenson as primarily a travel-writer and essayist long after he had turned seriously to fiction in an effort to increase his audience (and his income) in England. Not until 1885 did American critics begin to use a few superlatives to describe his talents as a romancer and short-story writer.

In the early 'eighties, the lack of international copyright encouraged literary piracy, and several of Stevenson's books were published in America without profit to him. Until Charles Scribner's Sons, in 1885, offered to pay him ten per cent royalties on the sales of their edition of *A Child's Garden of Verses*, he probably had not received more than five hundred dollars all told from American editors and publishers. He had not, therefore, had much incentive to write directly for the American market, but this transaction with Scribners opened his eyes to new opportunities and marked the beginning of a mutually profitable relationship which was to last for eight years.

1886 was the year in which Stevenson finally "arrived" as a popular writer of adventure and romance. In January of that year, *The Strange Case of Dr. Jekyll and Mr. Hyde* was a solid critical and commercial success. Widely publicized by press and pulpit, readily available to the masses in cheap reprints, the book became an overnight sensation and made Stevenson's name a household word in America. When his new novel, *Kidnapped*, was published in July, 1886, the Scribners sold nearly ten thousand copies in the first ten days. Within the space of little more than six months, two novels had gained for Stevenson a large popular following and had considerably enhanced his critical reputation as well.

The following year, with the appearance of *The Merry Men*, *Familiar Studies of Men and Books*, *Memories and Portraits*, and *Virginibus Puerisque*, Stevenson's stock with the critics reached a new high. They were practically unanimous in assigning him a high rank among living writers, and they confidently predicted that he would produce still greater work in the future. What might not be expected from a writer of such varied talents and high technical skills as he already had displayed? Stylist, moralist, brilliant romancer, short-story artist, essayist, composer of charming light verse -- he bolstered the faith of conservative critics and readers in the cherished values and ideals of the old established literary traditions. As each succeeding book revealed new facets of his remarkable talent, critics became increasingly convinced that Stevenson was an original literary genius, deserving of the highest praise and destined to rank with the great authors of the past.

When Stevenson arrived in America in the fall of 1887, he discovered that he was famous and that his name had a high commercial value. Joseph Pulitzer offered him ten thousand dollars a year to write a short weekly essay for the *New York World*; the Scribners countered with an offer of thirty-five hundred dollars for twelve monthly contributions to their magazine; Sam McClure was willing to pay eight thousand dollars for a novel that could be serialized in his newspaper syndicate.

As a professional literary man endeavoring to live by his pen, Stevenson had tried for years to come to terms with his public without sacrificing his artistic integrity. Critical acclaim and popularity were proof, in 1887, that he had succeeded in striking a happy balance, but these large offers posed a problem. Could he take advantage of them without compromising his standards? Could he write regularly for pay and still please himself and the critics? Events soon proved that he could not. When he began deliberately to exploit his American popularity, the quality of his work suffered. The temptation to make the most of his financial opportunities caused Stevenson to change his values. After 1887 he became increasingly inclined to place business before art.

During the last six years of his life, Stevenson wrote directly for the American market where the big money lay. Often he wrote hurriedly and without inspiration. The three novels written in collaboration with his step-son, Lloyd Osbourne, represent, to some extent, an effort on Stevenson's part to cash in on the value of his name without going through the entire, grueling creative process that had produced his best work. American popularity and the high prices that he could command in the periodical market were bad for Stevenson the artist. From 1888 on, he was, in a very real sense, always writing against time,

consciously making "hay with rather morbid eagerness while the sun shines." On the one hand, he was attempting to write novels with more complex artistic designs than his earlier novels had contained; on the other, his desire to exploit his earning power made him willing to settle for considerably less than perfect execution of those designs. The effect upon his lofty reputation of the novels produced under these conditions could not have been otherwise than unfortunate. In the process of evaluating *The Master of Ballantrae*, *The Wrecker*, *David Balfour*, and *The Ebb-Tide*, the critics were forced to revise somewhat their earlier high estimates of Stevenson's abilities. At the time of his death, in 1894, he was still looked upon as one of the finest writers of the time, but he was no longer quite the shining idol that he had been in 1887 when there seemed no limits to what he might accomplish.

A large body of unpublished correspondence (between Stevenson and Charles Baxter, his legal adviser and literary agent, and between Stevenson and various members of the Scribner publishing firm) proves conclusively that Stevenson in his later years cared more for literature as business than for literature as art.

Microfilm \$3.90; Xerox \$13.20. 301 pages.

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ROSE MACAULAY: A CRITICAL SURVEY

(L. C. Card No. Mic 59-2261)

Philip Louis Rizzo, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Edwin C. Bolles

This study is an attempt to provide a full-length descriptive and analytic survey of the materials and methods in the writings of Rose Macaulay (1884-1958). Primary emphasis is on her satiric novels but extended treatment is given also to her other novels, poetry, literary criticism, and essays. Biographical information and miscellaneous pieces are incorporated where especially illuminative.

Principal considerations are to determine the nature of her criticism of life and human society, to give some account of her most frequent themes and devices and the sources she drew from, to examine her position in current literary criticism, and to evaluate her performance and her contribution to the English satiric tradition. That Rose Macaulay's critical sensibility was evidenced in her first book, *Abbots Verney* (1906) which, illustrating in the manner of the naturalists that life was a *pis aller*, also made manifest dominant characteristics of Rose Macaulay's temperament: her libertarianism, her view of salvation and reform as individual matters, her veneration of propriety and scholarship, and her desire for effective strategies against threats of social environment. Of four succeeding solemnly objective novels, one suggested Henry James and one was emphatically Forsterian.

In 1912, coincident with international posturing for world war, her shift in style and method began, incorporating her theretofore latent faculty of wit and converting her

interest in character for its own sake--with the social criticism implicit and subservient--into direct social criticism with character subservient. Three books before 1920 evidenced her veering from solumnity, Forster, and James and her turning to the English and French tradition of "urbane and unriotous wits"--Congreve, Voltaire, Walpole, Austen, Lamb, Wilde, Beerbohm, and France.

Potterism (1920) fused her faculty of wit with her earlier reform notions and, though borrowing freely from the "elegant ironists"--chiefly Anatole France--whose muse she endorsed, brought together figures she earlier criticized and suggested a prescription for right conduct combinative of the defensive codes of her preceding novels. Establishing the complex use of character and family in multiple functions, Potterism provided also the manner, critical standards, and themes which dominated Dangerous Ages and Told By An Idiot. After this trilogy, only And No Man's Wit (1940) evidenced a return of satiric vigor combined with significantly new elements.

Remaining satires, from Orphan Island to I Would Be Private (the nadir of her satiric powers) show the decline of Rose Macaulay's art. The Towers Of Trebizond (1956), however, using early materials of her poetry and incorporating relatively new elements of style and material is, like Potterism, a culminating effort whose success may function to renew general critical interest which waned in the face of several failures after 1930.

The decline in critical attention to Rose Macaulay is more excessive than the works warrant. If not an originator, if a craftsman working in a resonance chamber of English and French satirists, if a borrower of materials and an adapter of a style forged by predecessors, she nevertheless at her best made the materials and the style inimitably her own. Hers was a "radiant sanity" and Potterism, which gave the fundamental design of the human spectacle and the nature of the follies as Rose Macaulay always viewed them, and The Towers of Trebizond, which added a dimension of intensity and style, together projected the quintessence of her personality and her vision. Properly she belongs to the continuous tradition of critical wits of England and France. With less than the fertile genius of Jane Austen, Rose Macaulay holds a position in the twentieth century in relation to that tradition if not comparable, analogous, to Jane Austen's in the nineteenth.

Microfilm \$2.75; Xerox \$9.60. 211 pages.

ZOLA AND FOURIER

(L. C. Card No. Mic 59-2262)

Alfred Dominic Roberts, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Carlos Lynes, Jr.,

The work of Fourier, along with that of other utopian socialists, served as a point of departure for the so-called scientific socialists, including Marx and Engels. Fourierism as a social doctrine touched the lives of many both in France and abroad, from industrialists to eccentric dreamers and crusading writers and humanitarians. The problem we are concerned with here is the question of when in his career and in what manner Zola came into contact with

Fourier and to what extent the doctrine of Fourier entered into the novelist's work.

A group of Fourier's disciples constituted what came to be known as the "Ecole sociétaire," which had its inception in 1830 and lasted to 1850. The ideas of Fourier continued to inspire practical experiments in socialistic living both in France and elsewhere in the course of the nineteenth century, and some of these experiments have endured in some form or other into the present century. Interest in Fourier was manifested also by creative writers including George Sand, Eugène Sue, Victor Hugo, and principally Leconte de Lisle and Emile Zola.

Zola, both in his correspondence and in his creative works, indicated an unusually large degree of interest in socialism. Critics recognize the desire for social reform implicit in the novels of the Rougon-Macquart series. This desire is stated explicitly by Zola in his correspondence. After the Rougon-Macquart novels, which represent a dispassionate analysis of the state of society as Zola found it, he wrote his Trois Villes series in which he shows more concern with working out a possible solution to certain social problems than with mere literary expression. It is in Paris, the third of the Villes trilogy, that he singles out Fourierism as the least objectionable among the various socialistic doctrines which confront the hero of the novel. It is with Travail, the second novel in the Quatre Evangiles series, that Fourierism is worked into the fabric of the novel to such an extent that it becomes almost a transposition in fictional form of Fourier's philosophy. The result is a thesis novel, which, along with the others in the Evangiles series, is generally inferior artistically speaking to the earlier works of Zola.

Travail, as the author himself admits, is of the nature of a Utopia. However, Zola had a practical, evangelistic end in view for each one of his Evangiles novels, as the title of the series implies, and in Travail he points up the need for a reorganization of modern industrial society along lines laid down by Fourier. The result would be a "communisme libertaire," as Jean Jaurès calls it in his "Conférence sur Travail d'Emile Zola," Revue socialiste, XXXIII (1901), 644. In such a society there will be absolute social equality combined with absolute freedom to develop as individuals and as members of social groups. This is what Zola found in Fourier's system.

Microfilm \$2.25; Xerox \$7.80. 169 pages.

SAINTE-BEUVE AS A CRITIC OF FRENCH POETRY

(L. C. Card No. Mic 59-2493)

Walton Hoyt Rothrock, Ph.D.
The University of Texas, 1959

Supervisor: Dr. C. A. Swanson

This dissertation is a critical and systematic examination of Sainte-Beuve's writings on French poetry, coordinating the opinions and views expressed in various places and at various times in order to discover the full significance of his criticism and his ultimate appraisal of French poetry. The arrangement of the study is chronological, with an index of authors for convenient reference.

Sainte-Beuve conceives of criticism as a creative

process aimed at the true reflection and representation of the author himself. He is interested in understanding rather than judging the poets, and therefore directs all of his attention toward their works and their lives. Denying the existence of absolute standards for judging poetry, Sainte-Beuve is seen to change or modify his opinions on various poets during his career. These changes are seen to be the result of becoming better acquainted with the poet or period in question, or else the result of Sainte-Beuve's personal attitude toward the poetry of his own day, which he tried to influence through his critical writings. His initial belief in the Romanticists and his ultimate disillusionment with them has a clearly discernible influence on his criticism and demonstrates the importance of relating his articles to the time at which they were written.

While Sainte-Beuve's opinions on specific poets and schools underwent changes, his personal tastes remained constant. Declaring the civilized and the refined world as his "climat natal" Sainte-Beuve shows himself an inadequate judge of the poetry of the Middle Ages. In spite of his idea of unbiased criticism, he is unable to appreciate the early French poetry which was too crude, and the post-Romantic poetry which was too complicated, for his taste.

Although there is a great deal of valid criticism of French poetry in Sainte-Beuve's work, showing his reliable feeling for beauty and harmony, his sharp perception and his own gift of expression, there are many defects both in his approach and in his conclusions. In his attempt to guide the direction of contemporary poetry, Sainte-Beuve willingly sacrifices his own standards of impartiality and objectivity and leaves himself open to criticism and condemnation. Microfilm \$4.55; Xerox \$15.40. 356 pages.

LOPE DE VEGA ON KINGSHIP

(L. C. Card No. Mic 59-2537)

Philip Rovner, Ph.D.

University of Maryland, 1958

Supervisor: Professor Frank Goodwyn

Lope de Vega's political precepts as found in more than one hundred plays form an *ars gubernandi* which is analyzed in connection with piety, justice, evidence, *razón de estado*, punishments, rewards, largess, the royal word, the *corte*, the *campo*, the natural analogy, depersonalization, political origins, secular and spiritual powers, and divine right.

The precepts are of two kinds: those that treat of the political person of the king and those that treat of the political institution of kingship. In the first instance, the precepts are similar to those uttered for centuries in pagan and Christian specula of princes, but modified in accordance with the religious and political difficulties of Europe in the sixteenth and seventeenth centuries. In the second instance, the precepts form a credo of government related to general political theory as it developed from the Middle Ages. In the plays there are described a partiality for a political theory that separates spiritual from secular power, and a marked adherence to the royalist theory of divine right of kings.

Ascription of democratism or constitutionalism to the

political material incidental to the plays, or to any play in particular, such as *Fuenteovejuna*, is erroneous and stems primarily from a failure to analyze carefully the relation of king to law and subject to king both in the plays and in the political ideology current in Europe during the sixteenth and seventeenth centuries. Nor can "reactionary" be ascribed to Lope, for in connection with his picture of the perfect prince his absolutism is one that works for social good in accordance with both the Platonic and Christian ideal of human rule through love, truth, and justice. Microfilm \$4.35; Xerox \$14.60. 338 pages.

THE AMERICAN SHORT STORY, 1930-1940; A STUDY IN FORM AND CONTENT.

(L. C. Card No. Mic 59-2496)

Ernest Benjamin Speck, Ph.D.

The University of Texas, 1959

Supervisor: Professor Martin Michael Crow

The American short story in the 1930's occupies a comparatively unique position in the history of form and content in the genre. The social, political, economic, literary, and critical worlds were all undergoing change. The short story had begun, before the opening of this century, a development along two separate lines of emphasis: naturalism and craftsmanship. Then the O. Henry story, with its emphasis on trick plots, became the vogue until the break from formula stories in the 1920's, when Sherwood Anderson, Ernest Hemingway, Ring Lardner, and a few other experimenters introduced the new non-formula story.

The non-formula story is any story which does not follow the plot pattern of a so-called "well made" play. In the 1930's four types of non-formula patterns were widely used: (1) the continuing conflict story, in which the conflict of the protagonist is not resolved; (2) expository narrative, in which narrative is used to delineate circumstance or character; (3) pattern of defeat, in which the fortunes of the protagonist steadily decline; and (4) the recognition story, in which the protagonist becomes aware of some facet of life or of his own personality of which he has not previously been aware. There were also non-formula stories published in the 1930's which do not fit into any of these categories. More than one-half the stories in the two annual short story anthologies (*Best Short Stories of 19* and *O. Henry Memorial Award Prize Stories of 19*) for the 1930's are non-formula stories.

Besides these new forms, writers used the formula when it was organic to the story, and they used "partial" plots involving only part of the full formula. They also availed themselves of a wide variety of uses of distance, point of view, internal narrative, and poetic mood to gain variant effects. Through these means writers made the short story a subtle and refined literary genre.

In the short stories of the 1930's two types of content are particularly significant: socio-economic and psychological. Some socio-economic stories contain economic conflicts, some use the depression as background to other problems, and some deal with such social problems as that of minority groups. The psychological stories are

often analytical of personalities, either assuming some knowledge of psychology by the reader or seeking to instruct him in psychology. Many psychological stories deal with children and adolescents. These two types of content appear in about one-third of the stories in the two anthologies for the 1930's, the others dealing with the usual assortment of conflicts found in short stories. Writers found non-formula so useful that three-fourths of the socio-economic stories and over half the psychological ones are non-formula, and thus content affected form.

Criticism of the short story in the decade contains two controversies: one centered on the non-formula story, the other centered on propaganda and art. Gradual acceptance of non-formula stories and a subsequent widening of the definition of the short story resolved the first controversy. The decline of the influence of those who believed that art should be a social weapon ended the second one.

The principal short story writers of the decade—William Faulkner, Erskine Caldwell, William March, John Steinbeck, Morley Callaghan, William Saroyan, Katherine Anne Porter, Kay Boyle, and Eudora Welty—made wide use of the forms, devices, and techniques typical of the period.

Short story writers in the 1930's produced a significant group of stories, and they integrated their art in a period of general dissolution in the world.

Microfilm \$2.55; Xerox \$8.80. 194 pages.

THE AMERICAN NOVEL IN GERMANY A STUDY OF THE CRITICAL RECEPTION OF EIGHT AMERICAN NOVELISTS BETWEEN THE TWO WORLD WARS

(L. C. Card No. Mic 59-2276)

Anne Marie Springer, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. E. Sculley Bradley

The reception of American literature--chiefly the novel of America--has become no less spectacular in Germany than in other European countries since the last war, and has engendered a number of scholarly investigations. There seems, however, to exist no study of Germany's attitude towards American fiction in the important years between World War I and World War II. But a study of German translations of American novels and of the response of the German reader and critic reveals a great upsurge of German interest in the modern American novel during the inter-war period.

In the early years of the Weimar Republic it was Jack London who held the widest appeal. Whatever reservations critics may have had in regard to his prolific pen, his double role of story teller and spokesman for the socialist cause established a popularity which reached the proportions of a vogue.

Often coupled with Jack London was Upton Sinclair, whose provocative exposure of a capitalistic society found an echo in the ranks of German socialists and communists.

The first major American author to compete with the fame of Jack London and Upton Sinclair was Sinclair Lewis,

whose reputation in Germany was already well established when he received the Nobel Prize in 1930. The avant garde saw Sinclair Lewis as an original author who had made new use of satire in his novels; the general reader and critic found in his work an expression either of their dislike of the U. S. A. or of their admiration for a nation which produced and encouraged such self-criticism.

After Sinclair Lewis, Theodore Dreiser conquered the German reader in 1927 with his *An American Tragedy*. Following in the wake of its great success, translations of *The Financier*, *The Titan*, *Jennie Gerhardt*, *Sister Carrie*, and *The Genius* appeared in quick succession. Dreiser's reception in Germany was somewhat marred by his frank espousing of unpopular views, his anti-clerical attitude, and his championship of the Soviet Union. His "belated naturalism" caused the avant garde critic to blush a little for him. If Dreiser found a sizable and appreciative reading public and favor with the German critics in time, it was on the basis of certain "German" virtues, such as seriousness, epic patience, and moving pathos.

Two main factors--a decline of interest in the reportorial novel of social protest and a desire for a new style and technique in novel writing--contribute to the popularity in Germany of Dos Passos, Hemingway, Faulkner, and Wolfe.

While never a popular success, Dos Passos ranked high with the German critics during the years between 1922 and 1932.

Hemingway found much response among the young German authors who thought the simple suggestiveness of his style irresistible.

Fascination with a new style and technique also figured in the reception of William Faulkner. The additional factor of a tacit Nazi approval assured Faulkner a continuous reception in a decade which spelled interruption for most of America's representative authors.

Several factors contributed to make Thomas Wolfe's reception in Germany one of unparalleled triumph. An alert publisher, a superior translator, Wolfe's love for Germany, his personal appeal, the non-political nature of his novels, their mystic and lyric quality, and his capacity to create a new image of America for the German reader all played their part.

If we were to assign a single outstanding motivation for the German reception of the American novel, we could do no better than quote Carl Van Doren on the main function of American literature abroad: that it has never ceased being "news from the New World to the Old."

Microfilm \$3.10; Xerox \$10.60. 239 pages.

**THE LITERARY REPUTATION OF VIRGINIA WOOLF:
A HISTORY OF BRITISH ATTITUDES TOWARD
HER WORK, 1915-1955**

(L. C. Card No. Mic 59-2282)

Robert Finis White, Jr., Ph.D.
University of Pennsylvania, 1959

Supervisor: Edwin C. Bolles

The purpose of this study was to trace the literary reputation of Virginia Woolf in Great Britain through the first forty years of its development. No effort was made to describe her popular success, to assay her influence, or to evaluate her work. All available direct treatments of her work were examined, as in reviews, essays, and full-length studies; and for indirect comment, a search was made through literary periodicals and textbooks and through the criticism, correspondence, memoirs, diaries, autobiographies, and biographies of any contemporary figures not entirely insignificant. For the dissertation these materials were reviewed in a fairly rigid chronological sequence. The conclusion consisted of a statistical survey of the seven-hundred-odd comments.

By far the most frequently praised aspect of Virginia Woolf's work was her prose style, her so-called "prose poetry." Of her twenty-one books appearing within the period, those most frequently and most favorably discussed were *The Common Reader*, *To the Lighthouse*, and *The Waves*. Initially her non-fiction attracted more favorable comment than her fiction, but subsequent to first reviews the fiction was much more frequently discussed: most critics apparently thought her essays less faulty than her novels but also less important. The fiction was most frequently criticized for its characterization, its

lack of narrative structure or moral design, and its remoteness from life.

A remarkable aspect of critical reaction to Virginia Woolf's work was the failure of the critics to compare her with other writers; the number of direct comparisons was inadequate to permit valid conclusions. Among the types of critics, there was no notable difference between the comment signed and that unsigned, nor between that of men and that of women. Book reviewers differed only negligibly from other kinds of critics in the nature of their reactions. There was some tendency for critics considering her work only one time to be more severe, and more decisive, than critics who commented a number of times.

The most striking feature of Virginia Woolf's literary reputation from 1915 to 1955 was its instability. For every three favorable comments her work received during that time she attracted one clearly unfavorable notice, and there were nearly as many uncertain or vacillating comments as favorable ones: the percentage ratio was 44-15-41. Furthermore, critical reaction shifted only slightly from decade to decade. At no time did the approvers of her work attain an outright majority of the total opinion, and though there was some decrease in the proportion of detractors as the period ended, the decrease was offset by the ever-growing number of critics who hedged or equivocated. In rough summary, the ratio of favorable, unfavorable, and uncertain judges was 3-1-2 in the first and second decades, 3-1-4 in the third decade, and 5-1-5 in the fourth decade, with the ratio for the full forty years being 3-1-3.

The most immediate conclusion drawn from these statistics was that from the beginning there had been disagreement among Virginia Woolf's critics: Indeed, she never achieved a clearly established literary reputation.

Microfilm \$5.20; Xerox \$18.20. 405 pages.

MATHEMATICS

COMPLEX GROUPS

(L. C. Card No. Mic 59-1721)

Wade Lee Allen, Ph.D.
The University of Florida, 1959

If A and B are complexes of a group G , then the complex product of A and B is the set of all elements of the form ab , where $a \in A$ and $b \in B$. A complex group G' from group G is any set of complexes of G which themselves form a group under complex multiplication. Any quotient group is a complex group, and for this reason complex groups may be regarded as generalized quotient groups.

All members, or elements, of a given complex group have the same cardinal number when regarded as subsets of G . The group postulates and the foregoing fact represent the only important properties shared universally by both complex groups and quotient groups. Beyond this point many differences ensue. The identity member E of a complex group G' from group G need not be a group. The identity element e of group G is not necessarily an element of E . Two members of G' may be comparable. Two members of G' may be intersecting, that is, neither disjoint nor comparable. Indeed, there exists a complex group which simultaneously contains a pair of disjoint members, a pair of comparable members, and a pair of intersecting members.

A complex group is disjunctive if its members are pairwise disjoint. Any complex group from a torsion group is disjunctive. A complex group is totally ordered if its members are pairwise comparable. Totally ordered complex groups always possess infinitely many members.

A complex group is elementary if its members are finite complexes of G. Every elementary complex group is a quotient group. A complex group is finite if it possesses finitely many members. No two members of a finite complex group are comparable.

A property P of a group G is divisible if every complex group from G possesses property P . The property of being abelian is an obvious divisible property. The properties of being a cyclic group, a torsion group, or a group of bounded order are divisible properties.

Microfilm \$2.00; Xerox \$3.00. 50 pages.

ON HIGHER ORDER BOUNDARY VALUE PROBLEMS FOR HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS IN TWO AND THREE VARIABLES

(L. C. Card No. Mic 59-1887)

Abdul Kadir Aziz, Ph.D.
University of Maryland, 1958

Supervisor: Research Professor Joaquin B. Diaz

This thesis is concerned with boundary value problems of Ingersoll's type [7] [8] for linear hyperbolic partial

differential equations of the second and third orders in two and three independent variables respectively. In these boundary value problems, higher order partial derivatives may occur in the boundary conditions (see below). The same boundary value problems are also considered for non-linear partial differential equations.

The boundary value problems considered are the following:

$$\begin{aligned}
 \text{(A)} \quad & \begin{cases} u_{xyz} + au_{xy} + bu_{xz} + cu_{yz} + du_x + eu_y + fu_z + gu = h(x,y,z) \\ u_{ono}(x,0,z) = \phi(x,z) \\ u_{moo}(0,y,z) = \chi(y,z) \\ u_{oop}(x,y,0) = \psi(x,y) \\ \phi_{mp}(0,0) = \chi_{np}(0,0) = \psi_{mn}(0,0) \end{cases} \\
 \text{(B)} \quad & \begin{cases} u_{xy} + au_x + bu_y + cu = f(x,y,u) \\ u_{mo}(0,y) = g(y) \\ u_{on}(x,0) = h(x) \\ h_m(0) = g_n(0) \end{cases} \\
 \text{(C)} \quad & \begin{cases} u_{xy} + au_x + bu_y + cu = f(x,y,u,u_x,u_y) \\ u_{mo}(0,y) = g(y) \\ u_{on}(x,0) = h(x) \\ h_m(0) = g_n(0) \end{cases} \\
 \text{(D)} \quad & \begin{cases} u_{xy} + au_x + bu_y + cu = f(x,y) \\ u_{mn}(x, \phi(x)) = g(x), u_{pq}(x, \phi(x)) = h(x) \text{ on } y = \phi(x) \end{cases}
 \end{aligned}$$

In section (1) we consider the boundary value problem (A) with constant coefficients. We prove that (A) has a unique solution if the functions f , $\phi(x, z)$, $\chi(y, z)$ and $\psi(x, y)$ satisfy certain differentiability conditions. We reduce our problem to the classical problem by determining $u(x, y, 0)$, $u(x, 0, z)$ and $u(0, y, z)$.

Section (2) deals with (A) where the coefficients a, b, c, d, e, f and g are variables. We obtain the same results as in section (1), provided the coefficients a, b, c, d, e, f and g and the functions $\psi(x, y)$, $\phi(x, z)$, $\chi(y, z)$ are sufficiently differentiable, and a certain determinant consisting of the coefficients a, b, c, d, e, f and g and their derivatives, does not vanish in the domain under consideration.

Section (3) deals with boundary value problem (B). We prove in this section that our boundary value problem has a solution (not necessarily unique) if certain functional equations have a solution. In this section we also prove a local theorem concerning a special case of (C), where $m = n = 1$, and we give a counterexample concerning the existence of a solution in the general case, that is when m and n assume any positive integral values.

Section (4) is concerned with boundary value problem (D). It is chiefly exploratory in character.

Microfilm \$2.00; Xerox \$3.00. 59 pages.

SUMMATION OF TRIGONOMETRIC SERIES BY A GENERALIZATION OF THE CESARO METHOD

(L. C. Card No. Mic 59-1608)

Billy Joe Boyer, Ph.D.
Purdue University, 1959

Major Professor: Aubrey H. Smith

Throughout this paper it is assumed that the function $f(x)$ is integrable in the Cesaro-Perron sense of order λ , $(C_\lambda P)$, for $\lambda = -1, 0, 1, \dots$. We define the $C_{-1}P$ integral to be the ordinary Lebesgue integral for convenience.¹

The r th derived Fourier series of a function $f(t)$, which is CP integrable over $[-\pi, \pi]$ and is of period 2π , at a point $t = x$ and the r th derived conjugate series of the Fourier series of $f(t)$ at $t = x$ are denoted by $D_r FS f(x)$ and $D_r CFS f(x)$, respectively.

The functions $\omega(t)$ and $g(t)$, which are closely related to the summability of $D_r FS f(x)$ and $D_r CFS f(x)$, are defined as follows:

$$\omega(t) = t^{-r} \left\{ \frac{f(x+t) + (-1)^r f(x-t)}{2} - \sum_{i=0}^{\left[\frac{r}{2}\right]} \frac{a_{r-2i}}{(r-2i)!} t^{r-2i} \right\} \text{ and}$$

$$g(t) = r! t^{-r} \left\{ \frac{f(x+t) + (-1)^{r-1} f(x-t)}{2} - \sum_{i=0}^{\left[\frac{r-1}{2}\right]} \frac{\bar{a}_{r-1-2i}}{(r-1-2i)!} t^{r-1-2i} \right\}.$$

The a_{r-2i} and \bar{a}_{r-1-2i} are real numbers which do not depend on t . For $r = 0$ the polynomial part of $g(t)$ is omitted.

We seek an answer to the following problem: Using only the class of CP integrable functions, can we reduce the summability problem for $D_r FS f(x)$ and $D_r CFS f(x)$ to that of FS $\omega(0)$ and CFS $g(0)$? Using the Bosanquet-Linfoot summability scale,² we obtain the following theorems:

Theorem 1. Let $f(x) \in C_\lambda P[-\pi, \pi]$ and be of a period 2π .

If there exist constants a_{r-2i} , $i=0, 1, \dots, \left[\frac{r}{2}\right]$, such that $\omega(t) \in C_{\mu}P[0, \pi]$ and FS $\omega(0) = O(\alpha, \beta)$ for $\alpha = 1 + \xi$, $\beta > 1$ or $\alpha > 1 + \xi$, $\beta \geq 0$, where $\xi = \min[\mu, \max(r, \lambda)]$, then $D_r FS f(x) = a_r(\alpha + r, \beta)$.

Theorem 2. Let $f(x) \in C_\lambda P[-\pi, \pi]$ and be of period 2π . If $D_r FS f(x) = a_r(\alpha + r, \beta)$ for $\alpha = 1 + \lambda$, $\beta > 1$ or $\alpha > 1 + \lambda$, $\beta \geq 0$, then there exist constants \bar{a}_{r-1-2i} , $i=0, 1, \dots, \left[\frac{r}{2}\right]$, such that $\omega(t) \in C_{\mu}P[0, \pi]$ for some μ , and FS $\omega(0) = O(\alpha', \beta')$ where

$$\left\{ \begin{array}{l} \alpha' = 1 + \xi, \beta' > 1 \text{ if } 1 + \lambda \leq \alpha < 1 + \xi \text{ or } \alpha = 1 + \xi, \beta \leq 1 \\ \alpha' = \alpha, \beta' = \beta \text{ if } \alpha = 1 + \xi, \beta > 1 \text{ or } \alpha > 1 + \xi, \beta \geq 0 \end{array} \right\}$$

and $\xi = \min[\mu, \max(r, \lambda)]$.

With the same meanings of $f(x)$, λ , α' , β' , and ξ , the conjugate analogues of these two theorems are

Theorem 4. If there exist constants \bar{a}_{r-1-2i} , $i=0, 1, \dots, \left[\frac{r-1}{2}\right]$, such that $g(t) \in C_{\mu}P[0, \pi]$ and CFS $g(0) = \ell(\alpha, \beta)$ for $\alpha = 1 + \xi$, $\beta > 1$ or $\alpha > 1 + \xi$, $\beta \geq 0$, then $D_r CFS f(x) = S(\alpha + r, \beta)$.

Theorem 5. If $D_r CFS f(x) = S(\alpha + r, \beta)$ for $\alpha = 1 + \lambda$, $\beta > 1$ or $\alpha > 1 + \lambda$, $\beta \geq 0$, then there exist constants \bar{a}_{r-1-2i} ,

$i=0, 1, \dots, \left[\frac{r-1}{2}\right]$, such that $g(t) \in C_{\mu}P[0, \pi]$ for some μ , and CFS $g(0) = \ell(\alpha', \beta')$.

The sums ℓ and S , if either exists, have integral representations in terms of the function $g(t)$.

These four theorems generalize results of Bosanquet and others.³ These theorems also show that the Cesaro summability of $D_r FS f(x)$ and $D_r CFS f(x)$ is equivalent to the Cesaro summability of FS $\omega(0)$ and CFS $g(0)$ which, in turn, is characterized by the Cesaro behavior of $\omega(t)$ and $g(t)$ as t tends to zero.⁴ In this sense we have a solution to the Cesaro summability problem for $D_r FS f(x)$ and $D_r CFS f(x)$ when $f(x)$ is CP integrable.

The following theorems give sufficient conditions for the (α, β) summability of FS $\omega(0)$ and CFS $g(0)$ in terms of the Cesaro behavior of $\omega(t)$ and $g(t)$ as t tends to zero. With Theorems 1 and 4 above, they provide sufficient conditions for the $(\alpha + r, \beta)$ summability of $D_r FS f(x)$ and $D_r CFS f(x)$.

Theorem 3. Let $\omega(t)$ be an even, periodic, $C_{\mu}P$ integrable function over $[0, \pi]$. If $\omega(t) = O(1)(C, k+1)$ and $\omega(t) = o(1)(C, k+2)$ as $t \rightarrow 0$, where $k \geq \mu$, then FS $\omega(0) = O(k+1, \beta)$, $\beta > 1$.

Theorem 6. Let $g(t)$ be an odd function of period 2π . If $t^{-1}g(t) \in C_k P[0, \pi]$ where k is a non-negative integer, then CFS $g(0) = -\frac{1}{\pi} \int_0^\pi g(t) \cot \frac{t}{2} dt (1+k, \beta)$, $\beta > 1$.

The last two theorems generalize results of Burkill and Sargent.⁵ With the aid of Theorem 3, it is shown that the converse to Burkill's theorem is false.

Microfilm \$2.00; Xerox \$5.80. 119 pages.

1. For $\lambda \geq 0$, the $C_\lambda P$ scale of integration had been introduced and extended by Burkill (6), (7) and (9).
2. Bosanquet and Linfoot (5).
3. Bosanquet (1), (2) and (3); Wang (21); Zygmund (23); Takabashi and Wang (20).
4. Sargent (14), Theorem 3 for CFS and Theorem 6 for FS.
5. Burkill (8) for FS; Sargent (14), Theorem 1, for CFS.

TWO CHARACTERIZATIONS OF A CLASS OF METABELIAN p-GROUPS

(L. C. Card No. Mic 59-2008)

Peter George Braunfeld, Ph.D.
University of Illinois, 1959

The thesis demonstrates in detail the equivalence of two characterizations (due to Brahana) of a class of metabelian groups of exponent p . A metabelian group is a group whose commutator subgroup K is entirely contained in its center C . The two characterizations are referred to as Method I and Method II.

In Method I the starting point is an abelian group H of type $(1, 1, \dots, 1)$. The procedure consists of adjoining operators u of order p from the holomorph of H . With respect to a basis chosen in H , these operators u may be represented as matrices over $GF(p)$. It is known that the resulting groups G are metabelian of exponent p only if all the operators u adjoined have minimum polynomial of

degree 2. Such an operator u is said to be of type γ if its γ -th invariant factor is of degree 2, but its $(\gamma + 1)$ -st invariant factor is of degree 1. The groups G may then be distinguished by considering the various types of operators u contained in $U \cong G/H$.

In particular, the class of groups G considered have the defining relations;

$$\begin{aligned} u_1^{-1}h_1u_1 &= h_1h_3 & u_2^{-1}h_1u_2 &= h_1h_4 & u_3^{-1}h_1u_3 &= h_1h_5 & (1) \\ u_1^{-1}h_2u_1 &= h_2h_4 & u_2^{-1}h_2u_2 &= h_2h_5 & u_3^{-1}h_2u_3 &= h_2(h_3^2h_4^2h_5^2) \end{aligned}$$

as well as $x^p = 1$ for every $x \in G$. All other elements in G commute.

This defines a class of metabelian groups G on 5 generators, of order p^5 , with $K = C$ of order p^3 . Two groups, G and \bar{G} , of this class will be isomorphic precisely when the two polynomials: $p(x) = x^3 + cx^2 - bx + a$ and $\bar{p}(x) = x^3 + \bar{c}x^2 - \bar{b}x + \bar{a}$ have the same number of distinct linear, irreducible quadratic, or irreducible cubic factors. The number of distinct linear factors of $p(x)$ determines the number of independent operators u of type 1 in U .

Method II considers first the maximal metabelian group M of exponent p on 5 generators for which $K = C$. This is a group of order p^{15} . Any other metabelian group G of exponent p , on 5 generators, for which $K = C$ is now a factor group, M/H of M by a subgroup H with $H \cong K$. The two groups, K and M/K are abelian of orders p^{10} and p^5 , respectively. Thus, K may be represented as a 9-dimensional projective space, S , while M/K may be represented as a 4-dimensional projective space X . Coordinate systems may be chosen in X and S so that a point of S corresponds to a commutator of M precisely when its (point) coordinates are the Plücker line coordinates of a line in X . Denote the set of such points by V . V is defined by a system of homogeneous quadratic equations. The subgroup H of K for the factor group M/H corresponds to a subspace T of S which is to be annihilated. The relationships of T to V determine the various factor groups obtained. To obtain the class of groups defined by (1), T must be 10-dimensional. The main result of the thesis may now be stated as follows:

To obtain the groups G defined by (1), the 10-dimensional subspace T of S must have the following properties: T can be decomposed into two 3-spaces having in common the point P_1 on V . One 3-space intersects V in P_1 and a plane. The other 3-space lies wholly in the tangent space of V at P_1 . Any plane of this 3-space not containing P_1 must intersect V in 0, 1, 2, or 3 points, depending on the number of distinct linear factors of $p(x)$.

The cases of analogous classes of groups with 4 and 6 generators are briefly considered by application of the results obtained for 5 generators.

Microfilm \$2.00; Xerox \$3.00. 39 pages.

ONE AND TWO POINT BOUNDARY VALUE PROBLEMS FOR ORDINARY LINEAR DIFFERENTIAL EQUATIONS CONTAINING A PARAMETER

(L. C. Card No. Mic 59-2351)

George Gilman Chapin, Jr., Ph.D.
University of Minnesota, 1959

Under certain well-known conditions, see for example H. L. Turrittin [Amer. J. Math., Vol. 58, pp. 364-376, 1936], the ordinary linear differential equation,

$$\begin{aligned} \frac{d^n y}{dx^n} + \rho^r P_1(x, \rho) \frac{d^{n-1} y}{dx^{n-1}} + \dots + \rho^{(n-1)r} P_{n-1}(x, \rho) \frac{dy}{dx} \\ + \rho^{nr} P_n(x, \rho) y = 0, \end{aligned}$$

possesses solutions whose asymptotic representations on an interval $a \leq x \leq b$ are of the form

$$y_i(x, \rho) \sim [z_{i,0}(x) + \frac{z_{i,1}(x)}{\rho} + \frac{z_{i,2}(x)}{\rho^2} + \dots] \exp \int_a^x \Omega_i(t, \rho) dt,$$

where $i = 1, 2, \dots, n$, ρ is a complex parameter, r is a positive integer, and the $\Omega_i(x, \rho)$ are characteristic polynomials in ρ which are either identically zero or are of the form

$$\Omega_i(x, \rho) = \rho^{r_i} \Phi_{i,0}(x) + \dots + \rho \Phi_{i,r_i-1}(x).$$

A two point boundary problem requires the solution $y(x, \rho)$ to satisfy boundary conditions prescribed at $x = a$ and $x = b$. In this paper it is presumed that certain derivatives are specified, namely $y(\alpha_j)(a, \rho)$ for $j = 1, 2, \dots, p$, where $0 \leq \alpha_1 < \alpha_2 < \dots < \alpha_p \leq n-1$, and $y(\beta_h)(b, \rho)$ for $h = 1, 2, \dots, q$, where $0 \leq \beta_1 < \beta_2 < \dots < \beta_q \leq n-1$, with $p + q = n$.

It is assumed that the characteristic polynomials are such that $\text{Re}(\Omega_i(x, \rho)) < 0$ for $i = 1, 2, \dots, n-m-\varphi$; $\Omega_i(x, \rho) \equiv 0$ for $i = n-m-\varphi+1, \dots, n-\varphi$; $\text{Re}(\Omega_i(x, \rho)) > 0$ for $i = n-\varphi+1, \dots, n$; and $\text{Re}(\Omega_i) < \text{Re}(\Omega_{i+1})$ for $i = 1, 2, \dots, n-m-\varphi, n-\varphi, \dots, n-1$. No restrictions are made as to the multiplicity of either the roots of the characteristic equation or the roots of certain auxiliary characteristic equations, which are used in calculating the Φ 's appearing in the characteristic polynomials.

It is shown that in certain cases the solution $y(x, \rho)$ (and its first $n-1$ derivatives) which satisfies the prescribed boundary conditions may be approximated, for large values of ρ in a suitable sector of the ρ -plane, by the solution $z(x)$ (and its corresponding derivatives) of a certain lower order "degenerate equation." The m boundary conditions which must be satisfied by this m^{th} order degenerate equation are obtained by ignoring the $n-m-\varphi$ conditions $y(\alpha_j)(a, \rho)$ for $j = \varphi-q+m+1, \dots, p$ and the φ conditions $y(\beta_h)(b, \rho)$ for $h = q-\varphi+1, \dots, q$ and by then formally setting $\rho = \infty$ in the remaining m conditions.

Valid approximations are obtained when $0 \leq \varphi \leq q$ with $m \geq q$ and when $q-m \leq \varphi \leq q$ with $m < q$, provided certain prescribed conditions are satisfied regarding the non-vanishing of certain quantities and provided the original boundary conditions grow no faster than at certain prescribed rates. The approximations for the solution $y(x, \rho)$ and its first $n-1$ derivatives are shown to be valid either in the entire interval $a \leq x \leq b$ or in more restricted intervals which do not include one or both end points. In these latter cases a so-called "boundary layer" undoubtedly exists

near each end point excluded. The nature of the solution $y(x, \rho)$ in such a boundary layer is not considered in this paper.

When $q < \varphi \leq n-m$ and when $0 \leq \varphi < q-m$ with $m < q$, it is also shown that in general the degenerate equation cannot be relied upon to supply satisfactory approximations for the solution $y(x, \rho)$ and its derivatives.

Certain results of I. S. Gradstein [Mat. Sbornik N.S. 27, Vol. 69, pp. 47-68, 1950; also Translation Number 82, Amer. Math. Soc., 1950] are obtained as a special case of the present analysis by setting $\varphi = 0$ and $r = 1$ and without excluding non-zero multiple roots of the characteristic equation. In addition portions of the work of W. Wasow [J. Math. Phys., Vol. 23, pp. 173-183, 1944] on the two point boundary value problem are formally verified. It appears that a broad extension of Wasow's work based on the details of this paper would be possible.

Microfilm \$2.70; Xerox \$9.40. 207 pages.

THE CAUCHY PROBLEM AND THE MIXED BOUNDARY VALUE PROBLEM FOR A NON-LINEAR HYPERBOLIC PARTIAL DIFFERENTIAL EQUATION IN TWO INDEPENDENT VARIABLES

(L. C. Card No. Mic 59-1895)

James Conlan, Ph.D.
University of Maryland, 1958

Supervisor: Professor J. B. Diaz

This paper proves existence theorems for the partial differential equation

$$u_{xy} = f[x, y, u(x, y), u_x(x, y), u_y(x, y)]$$

for the Cauchy problem and the mixed boundary value problem. The methods of proof are such as to lead directly to simple numerical methods for the construction of numerical solutions to these two problems.

Microfilm \$2.00; Xerox \$3.00. 52 pages.

VECTOR AND OPERATOR VALUED RADON MEASURES AND DISTRIBUTIONS

(L. C. Card No. Mic 59-1614)

Richard Eugene Dowds, Ph.D.
Purdue University, 1959

Major Professor: Michael Golomb

Let X be a locally compact Hausdorff space, $K(X)$ the space of real valued, continuous functions on X with compact support and furnished with the usual inductive limit topology; then $K'(X)$, the dual space of $K(X)$, is the space of (scalar) Radon measures in X . Let \mathcal{B} denote the Banach space of bounded linear operators on a (real) Hilbert space \mathcal{H} . An operator valued Radon measure in X is an element of $L(K(X), \mathcal{B})$, the space of continuous linear mappings of $K(X)$ into \mathcal{B} . The notion of a \mathcal{B} -measure (a measure in X , taking values in \mathcal{B}) is defined; if μ is a \mathcal{B} -measure and φ an element of $K(X)$, $\int \varphi d\mu$ is defined as an element

of \mathcal{B} . The mapping $\mu' : \varphi \rightarrow \int \varphi d\mu$ is a (bounded) operator valued Radon measure in X (Theorem 2.2.6). Conversely, if μ' is a bounded operator valued Radon measure in X , there is a \mathcal{B} -measure μ such that $\mu'(\varphi) = \int \varphi d\mu$ for every φ in $K(X)$ (Theorem 2.3.1). In order to represent the unbounded operator valued Radon measures in an analogous fashion, the requirements for a \mathcal{B} -measure are relaxed and the notion of an extended \mathcal{B} -measure is defined. Theorem 2.5.2: If μ' is an operator valued Radon measure in X , there is one and only one extended \mathcal{B} -measure μ in X such that $\mu'(\varphi) = \int \varphi d\mu$ for every φ in $K(X)$.

The above representation of operator valued Radon measures is applied to give a new proof of the Spectral Theorem for self-adjoint operators. If A is a bounded self-adjoint operator and if Σ is the spectrum of A , it is found that A generates, in a natural way, an operator valued Radon measure μ'_A in Σ . The \mathcal{B} -measure μ_A corresponding to the Radon measure μ'_A is generated by A , is a spectral measure; moreover, $A = \int \xi d\mu_A(\xi)$. A similar result is given for an unbounded self-adjoint operator A , but a different method is used to obtain the Radon measure μ'_A .

Distributions taking values in the space \mathcal{B} are also considered; they are called operator valued distributions. $\mathcal{D}'(\mathcal{B}) = L_b(\mathcal{D}, \mathcal{B})$, the space of operator valued distributions is furnished with the topology of uniform convergence on the bounded subsets of the Schwartz space \mathcal{D} of testing functions. It is found that the operator valued distributions generalize the operator valued Radon measures in the same way as scalar distributions generalize scalar Radon measures.

The derivative of an operator valued distribution is defined in the usual way. It is shown (Theorem 3.3.1) that the derivative of an operator valued distribution can also be obtained as the limit (in the sense of $\mathcal{D}'(\mathcal{B})$) of the usual difference quotient. Several other spaces of multilinear mappings are obtained which are algebraically and topologically isomorphic with $\mathcal{D}'(\mathcal{B})$ (Theorems 3.4.3, 3.4.6, and 3.4.8).

The tensor product, $\bar{S} \otimes \bar{T}$, of two operator valued distributions \bar{S} and \bar{T} is defined so that $\bar{S} \otimes \bar{T}$ is again an operator valued distribution. It is shown that the mapping $(\bar{S}, \bar{T}) \rightarrow \bar{S} \otimes \bar{T}$ is bilinear and continuous (Theorem 3.6.21).

The representation theory for operator valued Radon measures is extended to the case of Radon measures taking values in the space E' , where E' is the strong dual of a Hausdorff t -space E . An (E') vector valued Radon measure in X is an element of $L(K(X), E')$, the space of continuous linear mappings of $K(X)$ into E' . The notions of E' -measure and extended E' -measure are defined. Theorem 4.4.4: If μ' is an (E') vector valued Radon measure, then there is one and only one extended E' -measure μ such that $\mu'(\varphi) = \int \varphi d\mu$ for every φ in $K(X)$. The correspondence $\mu' \rightarrow \mu$ thus established is a one-to-one mapping of the space of vector valued Radon measures onto the space of extended E' -measures. The restriction of the mapping $\mu' \rightarrow \mu$ to the set of bounded vector valued Radon measures is a linear, one-to-one mapping of that set onto $\mathcal{M}(E')$, the space of E' -measures. A locally convex topology is defined for $\mathcal{M}(E')$ so that the linear mapping $\mu' \rightarrow \mu$ is also a homeomorphism (Theorem 4.3.2). Moreover, for the case when X is compact and E is a separable Banach space, a criterion for the existence of a Radon-Nikodym derivative of E' -measures is derived (Theorem 4.5.9).

Microfilm \$2.00; Xerox \$5.40. 109 pages.

DIFFERENTIATION ON MANIFOLDS

(L. C. Card No. Mic 59-2200)

Billy Lee Foster, Ph.D.
University of Washington, 1959

Chairman: Carl B. Allendoerfer

The natural objects to differentiate on a differentiable manifold are functions and tensors. However the usual notion of tensor is not adequate in the sense that the second and higher derivatives of a function and the first and higher derivatives of a tensor are not tensors. This difficulty may be circumvented in various ways, among them skew-symmetrizing the derivative or utilizing an affine connection. A more direct approach is to broaden the notion of tensor, which is done here by considering a transformation operator containing first and second derivatives of the local coordinate variables. This operator is a straight-forward generalization of the ordinary Jacobian which has the same formal properties, and thus gives rise to the generalized tensors.

In Chapter I various motivating examples of generalized tensors are given, in particular, it is shown that an affine connection may be identified with a generalized tensor, and that the pair consisting of an ordinary tensor and its derivative is a generalized tensor. Also, some direct sum decompositions of the spaces of generalized tensors are proved.

In Chapter II contractions of the new tensors are considered. It turns out that the generalized notion of tensor clarifies differentiation by means of connections and suggests a broader covariant differentiation process which includes differentiating with respect to the "tensor" connections of Bompiani, the Lie bracket operation, and Lie differentiation. The key to these developments is a pair of closely related contraction theorems which assert that the contraction of generalized tensors of appropriate types yield ordinary tensors.

Microfilm \$2.00; Xerox \$3.00. 36 pages.

THE SOLUTION AND HUYGENS' PRINCIPLE
FOR A SINGULAR CAUCHY PROBLEM

(L. C. Card No. Mic 59-1901)

David William Fox, Ph.D.
University of Maryland, 1958

Supervisor: Prof. Alexander Weinstein

This paper gives an explicit solution in the large of the singular Cauchy problem for the hyperbolic equation

$$\frac{\partial^2 U}{\partial t^2} + \frac{k}{t} \frac{\partial U}{\partial t} = \sum_{i=1}^m \left(\frac{\partial^2 U}{\partial x_i^2} + \frac{\lambda_i}{x_i} U \right)$$

with the initial data

$$U(x_1, x_2, \dots, x_m, 0) = f(x_1, x_2, \dots, x_m),$$

$$\frac{\partial U}{\partial t}(x_1, x_2, \dots, x_m, 0) = 0.$$

The exact range of the parameter k for which the solution

is given by an integral operator is determined. For all other non-exceptional values of k the solution is obtained by a recursive procedure which yields the analytic continuation in k of the integral. The question of uniqueness is extensively treated. A main part of the investigation is devoted to the formulation of a necessary and sufficient criterion for Huygens' principle and the comparison of it to the corresponding results for the regular Cauchy problem and for the singular Cauchy problem for the Euler-Poisson-Darboux equation.

Microfilm \$2.00; Xerox \$3.00. 43 pages.

ON SOME INTEGRALS OF ANALYTIC
ADDITIVE NUMBER THEORY

(L. C. Card No. Mic 59-2237)

Frederick Anthony Homann, Ph.D.
University of Pennsylvania, 1959

Supervisor: Professor Hans Rademacher

This dissertation studies a class of improper integrals arising in H. Rademacher's paper "Zur additiven Primzahltheorie algebraischer Zahlkörper. III. Über die Darstellung totalpositiver Zahlen als Summen von totalpositiven Primzahlen in einem beliebigen Zahlkörper." (Math. Zeit. 27, (1927), 322-426.) The integrals appear as factors in the principal term of R 's asymptotic estimate of the quantity A_m related to the number of representations of a totally positive field integer as the sum of m totally positive primes. Their non-vanishing is necessary if the principal term is to have a higher order of magnitude than the error term. R demonstrated non-vanishing only for totally real fields and for arbitrary fields where the m Hecke Grossencharaktere appearing in the definition of A_m are all identically 1, thus leaving open the question of their non-vanishing in arbitrary fields for other than principal Grossencharaktere.

Our first extension of his results is for quadratic imaginary fields where it is necessary and sufficient to show non-vanishing of integrals of the type

$$I_m = \int_0^\infty J_\nu(x) \frac{x^{1+\sum_{j=1}^m L_j} (2 + L_j \sqrt{4+x^2})}{(4+x^2)^{3m/2} (2 + \sqrt{4+x^2})^{\sum_{j=1}^m L_j}} dx$$

$$= \int_0^\infty J_\nu(x) A(x) dx.$$

The number m is the number of summands in the representation and the L_j 's are arbitrary non-negative integers which specify the m Grossencharaktere appearing in the definition of A_m . (If any $L_j = 0$, the associated Grossencharakter is identically 1.) The number ν is a non-negative integer determined by the L_j 's, and $J_\nu(x)$ is a Bessel function of the first kind. We prove that whenever the L_j 's are 0 or 1 the quantity I_m does not vanish by reducing the integral to a sum of integrals each of which can be evaluated in terms of Bessel functions $K_\nu(x)$ of the third type and developing some estimates to show that the sum is in all cases positive. This technique does not generalize.

A more powerful technique uses a result of R. G. Cooke which states that for $v \geq 0$ the loop areas a_0, a_1, \dots , enclosed by the graph of $J_v(x)$ and the X-axis for $x \geq 0$ form a monotonic decreasing sequence. Since for any set of L_j 's $A(x)$ is a positive function monotonically decreasing to 0 after a certain positive point, I_m can be written as an alternating series of positive-valued integrals whose upper and lower limits are the consecutive roots of $J_v(x)$. General conditions in terms of $J_v(x)$ and $A(x)$ guaranteeing the positivity or negativity of I_m are first derived, and then lemmas about the loop area sequence are developed using asymptotic estimates of F. J. Olver for the critical points and values of the $J_v(x)$ functions. The lemmas applied to the general conditions show the non-vanishing of certain specified infinite classes of integrals. These techniques however still do not exhaust all possible cases in the quadratic imaginary field.

Finally, the case of arbitrary algebraic number fields is considered. Here hypergeometric functions appear as factors in the integrands and Cooke's lemma does not apply. But estimation techniques similar to previous ones coupled with a theorem of Gauss on the behavior of hypergeometric functions for large real values of the argument give the result that in any such field there is an infinite number of non-vanishing integrals apart from those arising from principal Grossencharaktere. Once again this argument is not exhaustive.

Microfilm \$2.00; Xerox \$3.00. 51 pages.

ON MONOSPINES OF LEAST DEVIATION

(L. C. Card No. Mic 59-2242)

Robert Shepard Johnson, Ph.D.
University of Pennsylvania, 1959

Supervisor: Prof. Issac J. Schoenberg

Let n and k be non-negative integers, let $\xi_1 < \xi_2 < \dots < \xi_k$ be k given points, and define

$$x_+ = \begin{cases} x, & x \geq 0 \\ 0, & x < 0 \end{cases}.$$

A spline function of class (n, k) with knots $\{\xi_v\}$ is a function of the form

$$S_{n,k}(x) = P_n(x) + \sum_{v=1}^k \rho_v (x - \xi_v)_+^n,$$

where P_n is a polynomial of degree at most n and the ρ_v 's are arbitrary real numbers. A monospline of class (n, k) , $n \geq 1$, with knots $\{\xi_v\}$ is a function of the form

$$M_{n,k}(x) = x^n + S_{n-1,k}(x),$$

where $S_{n-1,k}$ is a spline function of class $(n-1, k)$ with knots $\{\xi_v\}$.

It is well known that, among all polynomials of degree n with leading coefficient one, the Tchebycheff polynomial T_n defined by

$$T_n(x) = 2^{-(n-1)} \cos(n \arccos x), \quad -1 \leq x \leq 1,$$

deviates least from zero on $[-1, 1]$, that the maximum

absolute deviation is achieved at precisely $n+1$ points of $[-1, 1]$ with alternating signs, and that the latter property characterizes T_n among all polynomials of degree n with leading coefficient one. In this paper we investigate the existence, uniqueness, and properties of monosplines of class (n, k) which deviate least from zero on $[-1, 1]$.

We show that a monospline of class (n, k) can have at most $n+2k$ zeros. Thus a monospline of class (n, k) , $n \geq 3$, being proportional to the integral of a continuous monospline of class $(n-1, k)$, can have at most $n+2k-1$ relative extrema. This limitation holds also for $n=1$ and 2. The main results obtained in this paper are contained in the following two theorems.

Theorem 1. Given any set of numbers e_1, \dots, e_{n+2k-1} , such that

$$\begin{cases} e_{n+2k-1} < e_{n+2k-2}, e_{n+2k-3} < e_{n+2k-4}, \dots, n+2k \geq 2, \\ e_{n+2k-2} > e_{n+2k-3}, e_{n+2k-4} > e_{n+2k-5}, \dots, \end{cases}$$

there exists a monospline $M_{n,k}$ of class (n, k) which has the e_v as its relative extrema, in the given order. That is, for $n \geq 2$ there is a sequence $x_1 < x_2 < \dots < x_{n+2k-1}$ such that $M_{n,k}(x_v) = e_v$, $1 \leq v \leq n+2k-1$. For $n=1$, there is a sequence $x_1 < x_2 < \dots < x_k$ such that $M_{1,k}(x_v^-) = e_{2v-1}$, $M_{1,k}(x_v^+) = e_{2v}$, $1 \leq v \leq k$.

Theorem 2. For each (n, k) there exists a unique monospline $M_{n,k}^*$ of class (n, k) which deviates least from zero on $[-1, 1]$. For $n \geq 2$, $M_{n,k}^*$ achieves its maximum absolute deviation, with alternating signs, at precisely $n+2k+1$ points of $[-1, 1]$, including both end-points, and this condition determines M^* uniquely.

We also construct the functions $M_{n,k}^*$ for $n=1, 2, 3$, and 4, and obtain rather crude upper and lower bounds to the maximum deviation from zero of $M_{n,k}^*$ on $[-1, 1]$.

Microfilm \$2.00; Xerox \$3.00. 36 pages.

LANGUAGES WITH EXPRESSIONS OF INFINITE LENGTH

(L. C. Card No. Mic 59-1847)

Carol Ruth Karp, Ph.D.
University of Southern California, 1959

Chairmen: Professor Henkin and Professor Dye

Let α be a regular infinite cardinal number, and suppose that a supply of primitive symbols is given. Assume that there are symbols of grouping, symbols for negation, implication, conjunction, and a set of propositional symbols. Then expressions of the language P_α are just well-ordered sequences of these symbols, where these sequences have order-type less than α . Well-formed formulas (wffs) are formed from the propositional symbols by the usual rules for negation and implication signs, plus a rule allowing the conjunction sign to operate on well-ordered sequences of wffs of order-type less than α . Then the languages P_ω are the familiar propositional languages.

Similarly, let β be a cardinal number at most α and also infinite. This time, assume that we have symbols of grouping, symbols for negation, implication, conjunction,

universal quantification, a supply of n -ary function symbols, and a set of at least α individual variables. Expressions of the language $F_{\alpha\beta}$ are then well-ordered sequences of these symbols, these sequences again having order-type less than α . Wffs are formed from the elementary wffs by the usual rules for negation and implication signs, the rule we had in P_{α} for the conjunction sign, plus a rule permitting the sign of universal quantification to operate on a wff with a well-ordered sequence of variables of order-type less than β .

It is proved that wffs of these infinitary languages can be interpreted in semantic models and in α -complete Boolean algebraic models in a manner entirely similar to the familiar case $\alpha = \omega$ and $\beta = \omega$. The problem of constructing "formal systems" for these languages in which the semantically valid wffs are provable then becomes meaningful, though as yet the notion of an "acceptable" axiom schema or rule of inference is somewhat loosely defined. For the α -propositional languages, these problems are equivalent to certain set-theoretic representation problems for α -complete Boolean algebras, but for the (α, β) -functional languages, these problems are essentially new.

The classical propositional and first-order functional calculi can be modified in a natural way to apply to these infinitary languages. For the moment, let us call these the basic systems for P_{α} and $F_{\alpha\beta}$. The basic systems for P_{α} are semantically complete just in case $\alpha \leq \omega_1$. If $\alpha > \omega_1$, one can form a wff expressing the (ω_1, ω_1) -distributive law, this wff being semantically valid, but not provable in the basic system for P_{α} . The basic systems for $F_{\alpha\beta}$ are semantically complete just in case $\alpha \leq \omega_1$ and $\beta = \omega$. In a language $F_{\alpha\beta}$ with $\alpha \geq \omega_1$ and $\beta \geq \omega_1$, one can express the principle of dependent choices (if for each x there is a y such that $x R y$, then there is a sequence x_0, \dots, x_n, \dots such that $x_n R x_{n+1}$, $n = 0, 1, \dots$). This wff is semantically valid but not provable in the basic systems. It is shown that the wffs that are provable in the basic systems are exactly those valid in all α -complete Boolean algebraic models.

For each $\alpha > \omega_1$, propositional schemata H_{α} are described with the property that adding H_{α} to the basic axiom system makes the resulting system for P_{α} semantically complete. But it turns out that if $\alpha \geq \omega_1$ and $\beta \geq \omega_1$, even if we add schema H_{α} to the basic axiom system for $F_{\alpha\beta}$, the wff expressing the principle of dependent choices remains unprovable. Acceptable semantically complete systems are found for certain α and β by adding H_{α} to the basic axiom system, and then introducing a new axiom schema (in some cases) or rule of inference (in other cases) expressing an extended principle of dependent choices. Microfilm \$2.40; Xerox \$8.40. 184 pages.

I. ON HAAR'S THEOREM CONCERNING
CHEBYCHEV APPROXIMATION PROBLEMS
HAVING UNIQUE SOLUTIONS.
II. BOUNDARY VALUES OF
CONTINUOUS ANALYTIC FUNCTIONS.

(L. C. Card No. Mic 59-2251)

John Carl Mairhuber, Ph.D.
University of Pennsylvania, 1959

Supervisor: Prof. I. J. Schoenberg

I. In this paper, the following problem is considered. For what compact point sets M of E_k , consisting of $n \geq 2$ points, can n real continuous functions $f_1(x), \dots, f_n(x)$ be defined, such that for any real continuous function $f(x)$ defined on M , the problem of finding

$$(1) \min_{a_i} \max_{x \in M} |f(x) - \sum_{i=1}^n a_i f_i(x)|$$

shall have a unique solution a_1, \dots, a_n ? It is shown that it is necessary and sufficient that M be the homeomorph of a closed subset of the circumference of a circle.

The proof is obtained by means of an auxiliary theorem: A compact set of M in E_n , having the property that at most n points of M lie on any hyperplane of E_n , is the homeomorphic image of a closed subset of the circumference of a circle. This theorem is applied to Haar's Theorem (Mathematische Annalen, vol. 18 (1918) pp. 294-311), which states that necessary and sufficient conditions on the functions $f_i(x)$, $i = 1, \dots, n$, such that the solution to (1) be unique, is that any linear combination

$$a_1 f_1(x) + \dots + a_n f_n(x)$$

vanish in at most $n-1$ points of M .

II. Let D be a domain of connectivity n of the complex plane bounded by the n smooth curves C_1, C_2, \dots, C_n , such that C_1, \dots, C_{n-1} are interior to C_n . Let E_i be a closed subset of Lebesgue measure 0 of C_i , $i = 1, \dots, n$. Let $\phi(z)$ be a function defined and continuous on the set $E = \bigcup_{i=1}^n E_i$, and let T be the homeomorphic image of the

closed unit disc, such that the range of ϕ is contained in T .

The theorem proved in this paper is that there exists a function $f(z)$ defined and continuous on the closure \bar{D} of D , analytic and single valued in D , such that $f(z) = \phi(z)$ for $z \in E$, and such that the range of f is contained in T . The result is an extension of a theorem proved by Walter Rudin (Proc. Amer. Math. Soc. vol. 7 no. 5 (1956) pp. 808-811), which establishes the above theorem for simply connected domains.

The proof coincides in part with that given for simply connected domains. The extension to multiply connected domains is obtained by means of the harmonic measures of the boundary components of D .

Microfilm \$2.00; Xerox \$3.00. 21 pages.

METRIC DENSITY OF SETS

(L. C. Card No. Mic 59-2418)

Nathaniel Frizzel Grafton Martin, Ph.D.
Iowa State College, 1959

Supervisor: H. P. Thielman

It is known from Lebesgue's density theorem that at almost every point of a measurable set S in E^1 (the real line) the metric density exists and is one and at almost every point of the complement of S the density exists and is zero.

In the first part of this dissertation the author shows that for any number δ , such that $0 \leq \delta \leq 1$, and for any real number a there exists a measurable set S in E^1 such that the metric density of S exists at a and has the value δ . Thus if $\underline{E}(a)$ denotes the class of all measurable sets from E^1 whose density exists at a , the metric density at a , denoted by D_a , is a function on $\underline{E}(a)$ onto the closed unit interval. The properties of this function, and the properties of $\underline{E}(a)$ are examined. It is shown that D_a is finitely additive, subtractive, bounded, monotone, and non-negative; but it is neither countably additive nor countable subadditive. The class $\underline{E}(a)$ is closed under finite disjoint unions and proper differences, but it is not closed under arbitrary finite unions or intersections.

If $\underline{E}_0(a)$ and $\underline{E}_1(a)$ denote respectively the subclasses of $\underline{E}(a)$ which are mapped onto 0 and 1 by D_a , it is shown that $\underline{E}_0(a)$ and $\underline{E}_0(a) \cup \underline{E}_1(a)$ are both set rings and the following relationships exist between these classes and $\underline{E}(a)$:

- (1) If $E_1 \in \underline{E}_1(a)$ and $E \in \underline{E}(a)$, then $D_a(E_1 - E) = 1 - D_a(E)$, $D_a(E - E_1) = 0$, $D_a(E \cup E_1) = 1$, $D_a(E \cap E_1) = D_a(E)$.
- (2) If $E_0 \in \underline{E}_0(a)$ and $E \in \underline{E}(a)$, then $D_a(E_0 - E) = 0$, $D_a(E - E_0) = D_a(E)$, $D_a(E \cup E_0) = D_a(E)$, and $D_a(E \cap E_0) = 0$.

Next it is shown that the upper metric density of a measurable set S in E^1 at a point a of E^1 , denoted by $\bar{D}_a(S)$, is a finitely subadditive outer measure defined on the class \underline{M} of all measurable subsets of E^1 . Then if \underline{M}^* denotes the class of all \bar{D}_a -measurable sets, $\underline{M}^* = \underline{E}_0(a) \cup \underline{E}_1(a)$; and the \bar{D}_a -measure is the restriction of D_a to $\underline{E}_0(a) \cup \underline{E}_1(a)$.

Goffman (Proc. Am. Math. Soc. 1: 384-388. 1950) has shown that the set of points at which the metric density of a given measurable set exists but is different from zero or one is a set of the first category. As a partial converse he constructs a measurable set whose density exists at every point of an arbitrary F_σ of measure zero and has the value $\frac{1}{2}$. The following generalization of this result of Goffman's constitutes the main theorem of this dissertation.

Theorem. Let Z be an arbitrary F_σ of measure zero and let δ be a real number such that $0 \leq \delta \leq 1$. Then there exists a measurable set S such that the metric density of S exists at every point of Z and has the value δ .

Microfilm \$2.00; Xerox \$3.00. 58 pages.

SOME APPLICATIONS OF ORTHOGONAL SYSTEMS OF FUNCTIONS TO INTERPOLATION AND ANALYTIC CONTINUATION

(L. C. Card No. Mic 59-2256)

Jack Minker, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Bernard Epstein

In this dissertation several different problems relating to analytic continuation and interpolation with minimum norm are considered. The essential fact in each case is that the class of analytic functions under consideration forms a Hilbert space H , thereby allowing the techniques of the Hilbert space theory to be applied. Each of the Hilbert spaces H with which we deal is characterized by the existence of a (unique) kernel function, $K(z, \bar{t})$, possessing the "reproducing" property:

$$(1) \quad f(t) = (f(z), K(z, \bar{t})), \quad f(z) \in H.$$

The first problem concerns analytic continuation. A necessary and sufficient condition is obtained specifying whether a function, defined in a neighborhood of the origin by a power series, can be analytically continued into a domain D so that the function thus obtained belongs to the Hilbert space $L^2(D)$ consisting of those analytic functions quadratically integrable over D , that is

$$(2) \quad \|f\|^2 = \iint_D |f(z)|^2 dx dy < \infty.$$

The condition which is obtained depends only upon the coefficients of the power series and the coefficients of the Taylor expansion of the kernel function for $L^2(D)$. The result is less complicated than that given by Bergman in [1]. An application to the domain $D = D_{\pi/4} = \{|\operatorname{Im} z| < \pi/4\}$ is

then made. Another formulation of the aforementioned condition is then obtained. Comparing these formulas yields a relationship between certain sums of integers and the Bernoulli numbers.

Several different extremal interpolation problems are then solved. For the domain $D_\sigma = \{|\operatorname{Im} z| < \sigma\}$ we show that a necessary and sufficient condition on the constants $\{a_k\}$ so that there exist a function $f(z) \in L^2(D_\sigma)$ satisfying the interpolation conditions

$$(3) \quad f(K\pi) = a_k, \quad K = 0, \pm 1, \pm 2, \dots$$

is the following

$$(4) \quad \sum_{K=-\infty}^{\infty} |a_k|^2 < \infty.$$

The existence and uniqueness of a function in $L^2(D_\sigma)$ satisfying (3) with minimum norm (2) is established by using the Bieberbach Flaeichensatz and Hilbert space considerations. Noting that

1. the extremal function is orthogonal to the subspace Z of $L^2(D_\sigma)$ consisting of functions vanishing at the points $\{K\pi\}$, $K = 0, \pm 1, \pm 2, \dots$ and that

2. an isometry exists between functions in $L^2(D_\sigma)$ and the set of Fourier transforms of these functions, we show that

$$(5) f(z) = \sum_{n=-\infty}^{\infty} a_n \left[\frac{1}{2} \int_{-1}^1 \left(\frac{\sum_{K=-\infty}^{\infty} \frac{t-2K}{\sinh 2\sigma(t-2K)} e^{-2ikz} \right) e^{i(z-\bar{t})t} dt \right]$$

is the desired extremal function.

It is then shown that the condition (4) is also necessary and sufficient for a certain more general class of domains. When D is any such domain, the extremal function is obtained in the form

$$(6) f(z) = w(z) - Pw(z),$$

where $w(z)$ is any "competing" function and P denotes the orthogonal projection operator onto the subspace Z . Using the operator $Tg = \sin z g(z)$ which maps $L^2(D)$ onto Z we show that $P = T(T^*T)^{-1}T^*$, where T^* , the adjoint of the operator T , is given by

$$(7) T^*g(t) = \iint_D K(z, \bar{t}) \sin z g(z) dx dy,$$

where $K(z, \bar{t})$ is the kernel function (Bergman kernel function).

Applying the above techniques, with suitable modifications, it is then shown how to solve the following types of extremal problems.

1. The conditions (3) are imposed, but the Dirichlet norm

$$(8) \|f\|^2 = \iint_D |f'(z)|^2 dx dy$$

is used instead of the norm (2).

2. A finite number of interpolation conditions are imposed in the unit disc Δ and the norm (2) is to be minimized.

3. A sequence of points $\{z_k\}$ in the unit disc is given, where $\prod_{k=0}^{\infty} |z_k|$ is required to converge, the interpolation conditions

$$(9) f(z_k) = \delta_{kj}$$

are imposed, and the norm is given by

$$(10) \|f\|^2 = \int_{|z|=1} n(z) |f(z)|^2 |dz|,$$

where $n(z)$ is a given positive continuous function defined on the unit circle.

Microfilm \$2.00; Xerox \$5.40. 108 pages.

- [1] Bergman, S. - The Kernel Function and Conformal Mapping, American Math. Society, 1950, Math. Surveys, Number 5.

ON A THEOREM OF J. H. C. WHITEHEAD

(L. C. Card No. Mic 59-949)

Elvira Strasser Rapaport, Ph.D.
New York University, 1956

Adviser: W. Magnus

Using topological methods, J. H. C. Whitehead (On equivalent sets of elements in a free group, *Ann. Math.* v. 37. No. 4., 1936, pp. 782-800) has proved a theorem which allows to decide in a finite number of steps whether a given word in the generators of a free group is of minimal length. A special but typical case of his theorem is proved here by a purely group-theoretical method. The generic word of the free group is decomposed into syllables such that the total change in length of a word under a specified one of Whitehead's T-transformations can be computed from the change in length of the individual syllables. It is important to show that the length of the syllables needed for this purpose can be restricted, and this requires the discussion of a large number of special cases. Microfilm \$2.00; Xerox \$3.00. 42 pages.

MINERALOGY

WEATHERING SEQUENCE OF MICACEOUS MINERALS

(L. C. Card No. Mic 59-1609)

Roy DeBolt Bronson, Ph.D.
Purdue University, 1959

Major Professor: Joe L. White

Loss of potassium is known to accompany the natural weathering of micaceous minerals. The weathering sequence of muscovite mica was studied by preparing a series of "weathered" analogs from a relatively pure muscovite, Delamica. The "weathering" was accomplished by continuous leaching of the muscovite with molten lithium nitrate at 300°C. This treatment removed more than 90 percent of the interlayer potassium from the mica.

Increments of potassium were restored to the

potassium-depleted mica to produce a simulated weathering sequence. The basal spacings and the variation in x-ray diffraction intensities of the 001 and 002 reflections were measured on members of the series. A relationship was established between the 001/002 intensity ratio and the potassium content of the mica. The curve for this relationship is approximately linear for potassium contents between 1.2 and 3.0 percent.

An estimate of the extent of cleavage of the crystals along the ab-plane was made by the x-ray diffraction line broadening technique of measuring crystallite size. Assuming that each mica layer has a c-dimension of 10Å, the average number of associated layers in a crystallite was found to be 60 in the untreated material compared to 25 in the extremely depleted member of the series. Cleavage to this extent would expose less than 3 percent of the interlayer potassium. Therefore, removal of potassium

proceeds from the interlayer positions with the layers retaining their original orientation with respect to one another.

Infrared absorption spectra indicate that the structural OH in the octahedral layer is subject to considerable loss at temperatures below 400°C. The absence of an 3700 cm^{-1} absorption band indicates that the mica remains dioctahedral during and after removal of most of the potassium. Hence, it would appear that the reduction in surface

charge density is not due to movement of lithium into octahedral positions.

Infrared spectra of the treated mica, with monovalent interlayer cation as the variable, show differences in the broad absorption bands at lower frequencies. This indicates water having a greater degree of association as would be expected in interlayer water. Promise of this approach to study of interlayer water is indicated.

Microfilm \$2.00; Xerox \$4.40. 83 pages.

MUSIC

**A PAIR OF MASKS, 1. TRAGIC, 2. COMIC,
FOR SYMPHONY ORCHESTRA.
TRIO FOR VIOLIN, VIOLA, AND CELLO.**

(L. C. Card No. Mic 59-1671)

Robert B. Cantrick, Ph.D.
State University of Iowa, 1959

Chairman: Professor Philip Bezanson

The tragic and the comic are concepts of great suggestiveness to a composer. Their mere contrast suggests a dramatic form, complete in two balanced movements. Each is so rich in associations that it suggests a wide variety of musical treatments. And suggestions of universal profundity hover in the background.

From these suggestive possibilities the present music selects only a few as a point of departure. The first movement, under the spell of ancient Greek tragedy, would suggest the thrust of cosmic forces, outbursts of grief, and a nearly neurotic obsession with Fate. The second movement would celebrate such Rabelaisian aspects of comedy as uncurbed animal spirits, gigantic appetites, broad satire, and vulgarity. At the end of the score Pogo waits with a philosophic observation unifying the whole.

The mask of tragedy is first delineated in an introduction of three distinctly articulated phrases, assigned respectively to strings, brasses, and woodwinds. The contrasts in idiom and timbre of the three choirs and the three phrases becomes the basic thematic idea of the movement, as these three phrases are worked against each other contrapuntally in a variety of ways. These contrapuntal developments are frustrated time and again by interruptions of cup muted brass, *col legno* strings, and damped percussion. In the final, climactic interruption the brasses are open, the strings normal, and the percussion undamped. A coda follows, tapering off to *pianissimo* over a long series of repeated A-flats in the timpani.

The ending of the coda, like the ending of the first phrase of the introduction, cadences on an A-flat chord. This is the only intentional use of long-range tonal centers, all other harmonies developing in a free chromatic style, governed by the demands of the counterpoint.

A more disciplined chromatic style is used in the second movement. The comic mask is introduced by a twelve-tone row. Subsequent serial development of the row is interrupted by frequent dwelling on some group of tones, in order to heighten the impression of harmonic

movement when the remaining tones of the row are finally re-introduced. Near the middle of the piece the row is abandoned altogether. At the end the row returns combined with a popular tune of Rabelais' day, *L'Homme Armé*. The conclusion consists of warping the perfect and major intervals of this tune into the diminished and minor intervals of the row, while the row takes on the sing-song triple rhythms of the popular tune.

I am indebted to Dr. Bezanson for the original suggestion of a two-movement work, embodying the concepts of the tragic and comic masks.

TRIO FOR VIOLIN, VIOLA, AND CELLO

In over-all form this string trio progresses from a slow and thoughtful beginning movement through an *allegretto* middle movement to a final movement of driving energy. The form of each movement grows out of the nature of the opening material. In the first movement an improvisatory opening in chromatic style is subjected to free development for a time, using twelve-tone and serial techniques. Presently the opening motives return, somewhat varied, and another free development section ensues. This sort of procedure continues throughout the movement.

The concluding motive of the first movement becomes the opening motive of the second. This is a pair of intervals played staccato and piano: a perfect fourth followed by a minor ninth. In literal sequence the same pair of intervals is then repeated a diminished fifth lower. By contrast there follows, forte and legato, a pair of augmented fourths a half-step apart. Each pair of intervals contains four of the twelve chromatic tones. Throughout the movement the identity of these four-note groups is maintained intact, each being treated as a tetrachord capable of rearrangement in various melodic and harmonic shapes. The harmonic progressions of the movement are based on progression from one tetrachord to another.

The opening motives, being mannered and delicate in character, aroused associations at the time of composition with verse of similar character. Following this turn of thought, the movement soon shaped itself into a series of five "sonnets", each with 14 pentameter lines (5/4 bars), except the last which took an irregular form in its function as coda. Within each sonnet except the last the first eight bars, corresponding to the Petrarchan octave, develop the staccato idea of the opening motives; while the final six bars, the *sestet*, develop the legato idea. In working at the

problem of maintaining spontaneity and flexibility within such a highly formal organization, the isorhythmic technique in the motets of Machaut served as a model.

The final movement of the trio--by contrast--discards all conscious use of any chromatic, serial, rhythmic, or other intellectual formulas. The music attempts to unfold intuitively with only dramatic power as the guiding principle. An initial unison A provides a tonal center to which the piece returns from time to time and with which it concludes. The form is three-part, each section being a free development of the opening material. Two short contrasting sections separate the large sections. The compositional technique employed is chiefly motivic.

Microfilm \$2.00; Xerox \$5.60. 113 pages.

THE HIGH SCHOOL ORCHESTRA
AS AN INTEGRAL PART OF THE
MUSIC CURRICULUM IN FLORIDA, 1920-1957

(L. C. Card No. Mic 59-1841)

Eugene N. Crabb, D.M.E.
University of Southern California, 1959

Chairman: Professor Ralph E. Rush

It was the purpose of the study to collect, organize, and evaluate data on the high school orchestra as it was made manifest in (1) a history of the Florida high school orchestra and related music activity, (2) the importance and significance of causal factors of success and/or decline of high school orchestras in Florida, and (3) free responses of teachers of instrumental music and of school administrators toward problems of establishing and maintaining a string and orchestra program in the secondary schools of Florida.

A study of the history revealed that growth and development of the high school orchestra in Florida has been unstable, and that orchestra programs with long tenure were seldom existent except in some of the metropolitan areas. Individual orchestra success has been primarily a result of the interest and leadership of the individual orchestra director combined with the interest and cooperation of the school administration.

In the latter 1930's the high school band became the dominant instrumental music activity in the secondary schools of Florida. The school band has provided greater motivation for student participation than the orchestra and has been the most significant factor in the decline of Florida high school orchestras. It was concluded that future string and orchestra development is dependent on close cooperation and planning among the Florida Bandmasters Association, the Florida Orchestra Association, and the secondary school administrators of Florida.

There was general agreement in the responses of teachers of instrumental music and school administrators in Florida toward the problems of establishing and maintaining a string and orchestra program in their respective schools. Responses were recorded under specific subject areas which developed as an outgrowth of the grouping of related answers. It was found that with but one exception, secondary schools with string and orchestra programs had 850 or more student enrollment.

Recommendations. An analysis of the total study made manifests the following recommendations: (1) the high school orchestra be given maximum performance opportunities in Florida schools and communities, (2) the Florida Music Educators Association and its affiliated organizations assume the responsibility for raising the cultural standard of Florida schools and communities and for creating the opportunity for hearing and experiencing string and orchestra performance, (3) qualified orchestra teaching personnel be procured to provide string instruction at the elementary and junior high levels in those Florida schools desiring an orchestra, (4) an analysis be made of the music curriculum, of the instrumental teaching personnel potential, and of the distribution of special instruction services in secondary schools with 850 or more student enrollment without orchestra, (5) special consideration be given to counties with small enrollment for an increase in assignment of special instruction service units, (6) Florida teacher-training institutions encourage music education students and instrumental music teachers to become qualified teachers of strings and orchestra, (7) state certification requirements for the teaching of instrumental music in Florida include a minimum of one course in string instrument methods, (8) county superintendents assume county leadership in music curriculum content in the secondary schools of Florida.

Microfilm \$4.40; Xerox \$14.80. 342 pages.

LITERARY AND MUSICAL ASPECTS
OF ROMAN OPERA, 1600-1650

(L. C. Card No. Mic 59-2265)

Joseph Emilio Rotondi, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Joyce Michell

To my knowledge Hugo Goldschmidt's work, in German, published in 1901-1904, represents the only extensive criticism on the subject in print. The need for a study in English, as well as a reevaluation of the field, appears to be expedient.

My interest in the literary aspect concerns itself with the problem of the juxtaposition of comic and serious episodes in early Roman libretti. My investigation showed that this feature was a definite and common characteristic of the Italian comedy or *commedia* of the 16th and 17th centuries, based on Aristotelian literary criteria; i.e., *tragedia* portrayed the ideal life while *commedia* dealt with characters and incidents of life at a closer range.

It was pertinent, then, to investigate the sources of the libretti and it was found that categorical titles of certain poetic forms corresponded to the sub-titles of the libretti or operas of the 17th century. For example, *La Morte d'Orfeo* (1619) of Stefano Landi (1590-1655) bears the sub-title *tragi-commedia pastorale* and *La Catena d'Adone* (1626) of Domenico Mazzocchi (1592-1665), shows that of *favola boscareccia*. The two sub-titles mentioned above proved to be categorical titles for poetic works that were parodies or satires on the alleged higher forms of literature, namely; the tragedy, the epic and the pastoral. The comic element in these forms is represented by the

ridiculing and treatment of gods and heroes in terms of everyday life or in the spirit of *La Commedia dell'Arte*. Religious allegory, based on Catholic dogma, supplies the serious element. The co-existence of the comic and serious features and the paraphrasing of mythological themes necessarily places these forms in the category of *com-media* literature. Further, when a libretti was adapted from this type of literature and linked to music, the resultant form was the *commedia in musica*. The titles and the sub-titles, in many operas of the period, however, do not always indicate this musico-dramatic category. Therefore, five specific works were selected because their titles give no indication of this form and only in one instance does the sub-title definitely suggest such. Two of them have been mentioned above, the others are: *L'Aretusa* (1620) of Filippo Vitali (d. after 1649); *Diana schernita* (1629) of Giacinto Cornacchioli (dates unknown); and *La Galatea* (1639) of Loreto Vittori (1604-1670).

My preoccupation in the musical analysis is with the functional and formal aspects of the vocal and instrumental forms.

The vocal devices and forms run the gamut of late Renaissance and early 17th century practices, as may be seen in the soli, duets, trios and choruses of these works.

The chorus is the most striking and ever-present form, justifying, in many cases, the appellation "chorus opera" usually attached to Roman opera of this period. In the chorus the continuing interest in the techniques of the madrigal, frottola and coro spezzato is observed. In these vocal ensembles, as well as in the soli, duets and trios,

extensive use of the ostinato and strophic devices is also found.

The harmonic schemes show typical early "baroque" tendencies. Free chordal progressions exist that still retain some modal aspects.

The instrumental music is represented by the *ritornello*, *sinfonia* and *continuo*. The *continuo*, in keeping with the 17th century practices, appears as the lowest part of the instrumental ensembles and supplies the accompaniment for the soli and vocal forms. Very rarely is the instrumentation indicated in these scores.

The most conspicuous function of the *ritornelli* is to separate or connect the soli and ensembles in the *ostinato* and *canzona* episodes. These are frequently short interludes that very rarely show any musical relationship to the soli or ensembles.

The *sinfonia*, although generally used in Roman operatic production is found only twice in these five operas.

The dances are of three types: the instrumental (without text), the combination song and dance, and the solo. The last mentioned type is one in which instructions appear to be given to the singer that he dance as he sings. Definite directions as to the performance of the dances were not indicated on the score, leaving this phase of our study in the conjectural stage.

In closing, it must be mentioned that although this work does not harbor aspirations of exhausting the possibilities in this area, it should serve as a point of departure for future and deep criticism in the operatic domain of the 17th century. Microfilm \$3.70; Xerox \$12.60. 287 pages.

PHARMACOLOGY

A STUDY OF POTASSIUM TRANSPORT
IN SLICES OF RABBIT KIDNEY CORTEX

(L. C. Card No. Mic 59-1976)

William Oscar Berndt, Ph.D.
The University of Buffalo, 1959

A large part of the earlier work on energy requirements for potassium accumulation by renal cortex tissue was done by Mudge (*Amer. J. Physiol.* 165: 113, 1951; 167: 206, 1951; 173: 511, 1953). He studied the ability of slices of renal cortex of the rabbit to take up potassium from a low external concentration using the standard Warburg technique. The slices were depleted of potassium by leaching in potassium-free saline solution for 1.5 to 2.5 hours. The slices were then transferred to oxygenated Warburg vessels and oxygen consumption was followed for 30 minutes. At this time the tissues were analyzed for sodium and potassium. Mudge routinely used a temperature of 25° C. At 37.5° the potassium uptake by the tissue was less than at 25°. The standard substrate used was acetate though all of the tricarboxylic acid cycle intermediates he tested were equally effective. Mudge's work indicated that the system for potassium accumulation by surviving renal cortex slices of the rabbit is an active system, and that the system is probably specific for potassium, i. e., potassium accumulation is the primary process taking place.

The objectives of the present work were to revise the technique so that potassium uptake by renal tissue could be studied at a physiological temperature, and to characterize the transport system by the use of various inhibitors and substrates.

The technique was essentially the same as used by Mudge, but with two major modifications: (1) The time for leaching was reduced to one-half hour. It was felt that the shorter period of leaching would tend to preserve the integrity of the tissue and favor more normal ability to accumulate potassium. (2) A constant temperature bath rather than the Warburg apparatus was used for studying potassium uptake. This allowed the removal of tissue samples at various times so that the rate, as well as the extent of potassium uptake could be studied. Whenever a metabolic inhibitor was used, its effect on tissue oxygen consumption in the Warburg apparatus was tested before its effect on potassium uptake was studied.

The concentrations of sodium and potassium were measured in both fresh and leached slices of kidney cortex from 109 rabbits. During the leaching process sodium entering the tissue was balanced by an equivalent amount of potassium leaving the tissue. At both 25° C. and 37.5° C. potassium uptake was supported more efficiently by α -ketoglutarate than by succinate.

Of ten substrates studied at 37.5° C. glutamate, glutamine and α -ketoglutarate supported potassium uptake best, permitting the tissue during 40 minutes of incubation to

attain potassium concentrations almost equal to the concentrations in fresh tissue. Glucose was comparable to the above three substrates at 40 minutes, but the rate of uptake was slower. With fumarate, oxalacetate, malate and succinate the potassium uptake was not significantly greater than in experiments where no substrate was employed. Citrate and aspartate supported potassium uptake better than no substrate, but not as well as glutamate, glutamine and α -ketoglutarate. These experiments demonstrated a clear-cut substrate specificity for potassium uptake.

The effects of various alterations in experimental conditions upon potassium accumulation were extensively studied using α -ketoglutarate as the substrate. When magnesium was added to the medium potassium uptake was improved. An acid pH (6.0) did not interfere with potassium uptake. When rabbits were pretreated with desoxycorticosterone acetate (DOCA) potassium accumulation was stimulated. This is interesting because DOCA will cause a loss of potassium from the intact animal. Pretreatment with potassium chloride did not influence potassium uptake. An explanation for this is discussed. Since certain organic bases compete with potassium *in vivo* for secretion by the renal tubules (Kandel: Fed. Proc. 15: 444, 1956; Kandel and Domer: Fed. Proc. 16: 310, 1957), tetraethylammonium chloride and Darstine were tested for their ability to compete with potassium *in vitro*. No competition was demonstrated. Ammonium chloride inhibited potassium uptake without influencing tissue respiration. A possible mechanism by which ammonium chloride may act is discussed. Microfilm \$2.00; Xerox \$7.00. 148 pages.

**A STUDY OF THE COMPARATIVE IN VIVO
INHIBITION OF MONO-AMINE OXIDASE BY
1-ISONICOTINYL-2-ISOPROPYL HYDRAZINE
(IPRONIAZID, MARSILID) AND
BETA-PHENYLISOPROPYLHYDRAZINE (PIH)**

(L. C. Card No. Mic 59-2202)

John Harry Gogerty, Ph.D.
University of Washington, 1959

Chairman: Akira Horita

Some characteristics of the *in vivo* monoamine oxidase (MAO) inhibitory effects of Iproniazid and beta-phenylisopropylhydrazine (PIH) have been compared. Onset of MAO inhibitory effects of Iproniazid and PIH were determined by administering the drugs subcutaneously to rats at zero (0) time, then sacrificing and assaying for liver and brain MAO activities at 15, 30, 60, 120, and 240 minutes. A dose of 2.5×10^{-6} mole/kg. PIH reduced brain MAO activity approximately 65 per cent within 15 minutes after administration, progressing to a maximum of 80-85 per cent inhibition within 30-60 minutes. At this dose, PIH reduced liver MAO activity only slightly. On the other hand, Iproniazid at 10^{-5} mole/kg. reduced liver MAO activity almost maximally but a period of 2-4 hours was required for this. Brain MAO activity at this dose of Iproniazid was not affected during the course of the 240 minutes. When the dose of Iproniazid was increased to 10^{-4} mole/kg. liver MAO inhibition developed rapidly. At this dose, brain MAO was

also inhibited, but reached its maximum only after 2-4 hours. A comparison of the relative effectiveness of the two agents to inhibit MAO of liver and brain *in vivo* revealed that PIH and Iproniazid are approximately equi-active as *in vivo* inhibitors of liver MAO. A dose of 2.5×10^{-6} mole/kg. of either agent was required to produce significant reduction in liver MAO activity and, at 5.0×10^{-5} mole/kg., liver MAO activity was completely abolished. In regard to brain, PIH produced noticeable MAO inhibition with a dose of 5.0×10^{-7} mole/kg. and complete inhibition was seen at 5.0×10^{-6} mole/kg. Iproniazid, on the other hand, showed no brain MAO inhibition until a dose of 2.5×10^{-5} mole/kg. was reached, with complete inhibition occurring at about 2.5×10^{-4} mole/kg.

It thus appears from these investigations that beta-phenylisopropylhydrazine is approximately 50 times as effective as Iproniazid as an inhibitor of MAO activity in brain. Although the two agents appear to be equally effective on MAO activity of liver, the dose required of PIH to completely suppress liver MAO activity is five times that required to completely abolish brain MAO activity; on the other hand, the "tissue specificity" of Iproniazid is just the reverse, e.g., the dose required of Iproniazid to completely inhibit liver MAO activity is one-fifth that required to accomplish the same effect on brain MAO activity. These findings appear to be of special significance in view of the recent emphasis on study of MAO and its substrates in the brain and also in view of the recent reports concerning the toxic effects of Iproniazid on liver tissue when the agent has been used clinically as a "psychic stimulant."

Microfilm \$2.00; Xerox \$4.80. 92 pages.

**MERCURIAL DIURESIS IN DOGS
WITH DIABETES INSIPIDUS**

(L. C. Card No. Mic 59-1984)

Tracy Bertram Miller, Ph.D.
The University of Buffalo, 1959

It is generally agreed that the mercurial diuretics act by inhibiting the reabsorption of electrolyte by the renal tubules from the glomerular filtrate. However, there is still controversy about whether the site of action is in the proximal convoluted tubule or in the more distal segments of the nephron. The site of action was investigated in the present experiments by administering a mercurial diuretic to dogs with diabetes insipidus during a maximal water diuresis. In the absence of antidiuretic hormone, isotonic reabsorption of electrolytes and water continues as usual in the proximal tubule, but electrolyte reabsorption in the distal tubule occurs without an osmotic equivalent of water. The urine is therefore hypotonic and the free water clearance is high. If during water diuresis a mercurial inhibits electrolyte reabsorption in the distal segments, the increase in electrolyte excretion should not be accompanied by an increase in water excretion, because in the absence of antidiuretic hormone water reabsorption is already minimal. But if the mercurial inhibits electrolyte reabsorption in the proximal tubule, a volume of isotonic fluid larger than normal would be delivered to the distal segments,

where electrolyte reabsorption without an isosmotic equivalent of water could still occur. Both urine volume and electrolyte excretion would increase, and the free water clearance would be either the same as, or somewhat greater than before the mercurial was given. Experiments of this kind have been reported by others, but the results have been most discordant.

Since a steady state of maximal water diuresis is difficult to maintain in normal dogs, for the present experiments diabetes insipidus was induced in female dogs by surgical interruption of the supraoptico-hypophyseal tracts. Control experiments demonstrated that maximal urine flow and free water clearance can be maintained steadily for at least five or six hours, a period comparable to the duration of the mercurial experiments.

The procedure was as follows: After pretreatment for two days with 0.3 gm of ammonium chloride per kg per day, a water load of 5 per cent of body weight was administered orally to unanesthetized dogs with diabetes insipidus. Fluid and electrolyte balance was maintained by replacement of water and chloride (as sodium chloride) at the end of each twenty-minute clearance period. Mercaptomerin sodium equivalent to 1 mg of mercury per kg was injected intravenously after a constant maximal water diuresis was achieved (about three hours after the initial load). Analyses of plasma and urine were made to determine p-aminohippuric acid and creatinine clearances, osmolar and free water clearances and sodium, potassium and chloride excretion.

In each of twelve experiments on three dogs the mercurial caused an impressive chloruresis accompanied by a two-fold increase in urine flow. The increased flow lasted as long as water and salt replacement was continued (five hours in one experiment). The increment in urine flow consisted of isosmotic fluid, the free water clearance being essentially unchanged. Sodium excretion paralleled chloride excretion. The pH of the urine consistently decreased following the injection of mercaptomerin. The results are interpreted as good evidence that the major site of action of mercurial diuretics is proximal to the site of facultative water reabsorption. The results are compared with those of other investigators.

In some additional experiments, dimercaprol was injected intravenously to stop the mercurial effect. In one experiment dimercaprol reduced the chloruresis and urine flow but not to control levels. However in two experiments the chloruresis and urine flow fell below the control levels. Because of this the effect of dimercaprol alone was studied. Dimercaprol by itself reduced urine flow and decreased glomerular filtration rate and renal plasma flow.

In another series of experiments, the effect of vasopressin was determined at the height of superimposed mercurial and water diuresis. As expected, the free water clearance decreased, but urine flow remained at the same high rate as during the pre-vasopressin periods. The osmolar clearance and excretion of sodium and chloride increased strikingly. In a control experiment in which a water load was maintained but no mercurial was given vasopressin was infused at increasing rates. Urine flow and free water clearance decreased, but chloride excretion and osmolar clearance increased only slightly. Further studies of the conditions favoring a chloruretic effect of vasopressin are planned.

Microfilm \$2.15; Xerox \$7.60. 162 pages.

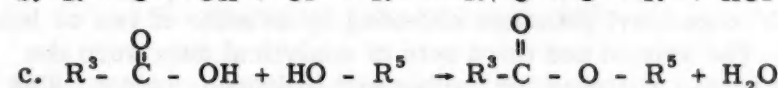
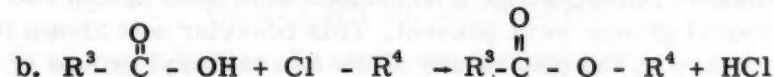
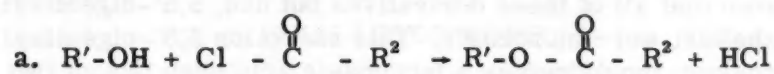
RECENTLY PREPARED DERIVATIVES OF GENTISIC ACID

(L. C. Card No. Mic 59-2301)

Willis Eugene Moore, Ph.D.
The Ohio State University, 1953

The work begun by Nash¹ in the field of esters of gentisic acid has been extended. Seven new derivatives of gentisic acid were prepared, their physical properties determined, and their proposed structures verified. In addition, the pharmacological activity of the seven new derivatives was determined in four selected pharmacological screening tests.

Four of the new derivatives were esters of gentisic acid with amino alcohols and three were esters of gentisic acid with other carboxylic acids. The seven new derivatives were prepared by three procedures according to the following general type-reactions:



in which R' = 1 carboxy, 2 hydroxy phenyl residue of gentisic acid, R² = an aromatic or aliphatic residue, R³ = 2,5 dihydroxy phenyl residue, R⁴ = a dialkylaminoalkyl residue and R⁵ = a tertiary or secondary aminoalkyl residue.

Type-reaction "a," which consisted of reacting an acid chloride with gentisic acid in ether in the presence of zinc chloride as a catalyst, produced 5,5'-digentisyl phthalate, 5-diphenylacetyl gentisic acid and 5-diethylacetyl gentisic acid. Type reaction "b," which was conducted according to the Horenstein-Pahliche method,² produced β-diethylaminoethyl-5-ethoxy salicylate hydrochloride. Type-reaction "c," which was carried out in the manner described by Feldkamp,³ yielded 3-(1-methylpiperidyl)-methyl gentisate hydrochloride, β-dimethylaminoethyl gentisate hydrochloride, and the compound believed to be β-n-butylaminoethyl gentisate hydrochloride.

The physical properties of the seven recently prepared derivatives of gentisic acid were determined and summarized.

The proof of the structures of the recently prepared esters of gentisic acid was based upon four qualitative tests and three sets of quantitative analytical data.

The first qualitative test was the production of a characteristic bluish-purple color by the reaction of each of these new compounds with aqueous ferric chloride solution. This color is a characteristic color reaction of ortho hydroxy carboxylic acids. Meta hydroxy carboxylic acids do not produce this color. Therefore, esterification of the meta hydroxyl group of gentisic acid occurred and esterification of its ortho hydroxyl group did not occur.

The second and third qualitative tests were performed upon the gentisic acid esters with amino alcohols to insure the presence of halogen in the compound. A white precipitate was produced by each compound when its aqueous solution was mixed with aqueous silver nitrate solution. Each compound imparted a green color to a nonluminous flame when in contact with metallic copper.

The fourth qualitative test was the examination of the infrared absorption spectrograph of each of the new derivatives and their comparison to the infrared absorption spectrograph of gentisic acid. It was found that gentisic acid and its derivatives possess a characteristic absorption triplet absorbing in the region of approximately 5.9μ , 6.1μ , and 6.3μ whenever the suspending solvent was Nujol. This absorption triplet was also present in the compounds prepared by Nash, et al.⁴ In addition, each compound possessed the characteristic absorption bands caused by the expected functional groups present in each compound.

One set of analytical data was the neutralization equivalent for each of the new derivatives. Each derivative prepared was acidic in nature: the esters of gentisic acid with amino alcohols contained hydrogen chloride; the esters of gentisic acid with other carboxylic acids contained one or two free carboxyl groups. These acidic functions were titrated potentiometrically in hydroalcoholic solvents with approximately 0.01 N sodium hydroxide solutions. It was shown that all of these derivatives but one, 5,5'-digentisyl phthalate, were monobasic. This exception 5,5'-digentisyl phthalate, functioned as a monobasic acid even though two carboxyl groups were present. This behavior was shown to be caused by the pK_a values of the two carboxyl groups of 5,5'-digentisyl phthalate differing by a factor of two or less.

The second and third sets of analytical data were the elemental analyses for carbon and hydrogen content. The values found experimentally were compared to the calculated values.

The formula of β -n-butylaminoethyl gentisate hydrochloride is in doubt because of inconsistent values for its neutralization equivalent and for its hydrogen content. These discrepancies are believed to be caused only by impurities present because of its solubilities, the positive ferric chloride test, and the presence of the characteristic infrared absorption triplet in its spectrograph.

The activity of the seven recently prepared derivatives of gentisic acid was determined in four selected pharmacological screening tests.

The acute toxicity of each new derivative was determined by intraperitoneal injection of a soluble salt into white Swiss mice and calculation of the lethal dose to fifty per cent of the mice by Behren's method.⁵ All of the new esters of gentisic acid were more toxic than the parent gentisic acid. In addition, they were relatively less toxic by this route of administration than were related derivatives given intravenously.⁶

The four esters of gentisic acid with amino alcohols contain the basic chemical groupings that are present in compounds now used as antispasmodic agents. These four esters were tested for antispasmodic action by a recognized procedure.⁷ Of the four esters, only β -diethylaminoethyl-5-ethoxy salicylate hydrochloride possessed sufficient activity under the conditions of the described screening procedure to warrant further study of its antispasmodic action.

The four esters of gentisic acid with amino alcohols also possess the basic chemical groupings that are present in compounds now in use as local anesthetic agents. Under the conditions of this screening test, only β -diethylaminoethyl-5-ethoxy salicylate hydrochloride possessed by appreciable local anesthetic activity. Since its activity was only slightly less than that of the standard selected, β -diethylaminoethyl-5-ethoxy salicylate hydrochloride should be investigated further as a local anesthetic agent.

Because the three esters of gentisic acid with other carboxylic acids and β -n-butylaminoethyl gentisate hydrochloride did not cause convulsions preceding death in the toxicity studies, these four compounds were screened for anticonvulsant activity. The screening procedure consisted of giving white Swiss mice a sublethal dose of the four esters, followed by a lethal dose of a recognized convulsant drug. None of the four esters of gentisic acid protected the mice from the lethal dose of the convulsant.

Microfilm \$2.00; Xerox \$5.40. 110 pages.

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Abstract published by special arrangement with The Ohio State University.

THE INFLUENCE OF SOME SUSPENDING AGENTS UPON THE RELEASE OF A SOLUBLE MEDICAMENT FROM SOLUTION

(L. C. Card No. Mic 59-1639)

Glenden David Redman, Ph.D.
Purdue University, 1959

Major Professors: G. J. Sperandio and J. E. Christian

Experiments were conducted to determine the effect of selected suspending agents on the dialysis of a soluble compound. A dialysis apparatus was instrumented so that a continuous measurement of the release of a radioactive soluble compound in the presence of a suspending agent was obtained. The release of the iodide ion from aqueous solutions containing different suspending agents in a one per cent concentration was evaluated by comparing dialysis rates. The effect of varying concentrations of Methocel 400 and Jaguar Gum upon the dialysis of the iodide ion was also determined.

Equal concentrations of suspending media affected the dialysis of the iodide ion in the following manner: Cato 8^a increased the rate over that of the control; all of the others retarded the release of the ion. Jaguar Gum^b produced the

greatest delay in the release followed by Tragacanth U. S. P., Veegum,^c Attagel 20,^d Locust Bean Gum, Superlose,^e Pectin N. F., Methocel 400,^f and Ramalin G^g in the order named. Tragacanth and Jaguar Gum released the compound at the same rate. Attagel 20 and Veegum also had the same general effect on the rate of release.

The effect of concentration of the agents tested, Methocel 400 and Jaguar Gum, indicated that an increase in the concentration does not proportionately alter the dialysis rate. Microfilm \$2.00; Xerox \$5.40. 110 pages.

a. A cationic corn starch derivative available from National Starch Products Inc., Plainfield, New Jersey.

b. A brand of Guar Gum available from Stein Hall & Co. Inc., New York, New York.

c. A form of magnesium aluminum silicate available from R. T. Vanderbilt Co., New York, New York.

d. An activated attapulgite clay available from Minerals & Chemical Corp. of America, Menlo Park, New Jersey.

e. A brand of amylose available from Stein Hall & Co. Inc., New York, New York.

f. A brand of methylcellulose U. S. P. available from Dow Chemical Co., Midland, Michigan.

g. A brand of amylopectin available from Stein Hall & Co. Inc., New York, New York.

THE DEVELOPMENT OF A LIQUID ANTIHISTAMINIC WITH SUSTAINED RELEASE PROPERTIES

(L. C. Card No. Mic 59-1644)

Harry Alcide Smith, Ph.D.
Purdue University, 1959

Major Professors: Glen J. Sperandio and
Robert V. Evanson

The objective of this problem was to develop a liquid antihistaminic preparation with sustained release properties. The work involved four phases: screening of several cation exchange resins for their capacity to adsorb methapyrilene; studying the rate of release of methapyrilene from its resin-adsorbates in vitro; formulating a stable suspension containing a selected resin-adsorbate; and studying the duration of antihistaminic activity of the formulated product in vivo.

The batch method was used to determine the capacity of several cation exchange resins to adsorb methapyrilene. The sulfonic acid resins showed a relatively higher capacity for adsorbing methapyrilene than the carboxylic acid resins and the amount of methapyrilene adsorbed by these resins was found to be inversely related to their degree of cross-linkage.

Based upon the rate of release, the extent of release over a twelve-hour period, the palatability, and the suspendability, the 4 per cent cross-linked resin with a 200-400 mesh range was selected as the best resin for obtaining an adsorbate of methapyrilene with sustained release properties.

Formulation of a stable suspension of the selected resin-adsorbate was accomplished using a combination of simple syrup, a one per cent solution of methylcellulose 1500 cps, sorbitan trioleate, and vanillin.

In vivo studies were conducted by comparing the duration of protection against histamine-induced asthma in the intact guinea pig afforded by a solution of methapyrilene and a suspension of the resin adsorbed methapyrilene. These studies showed that the resin-adsorbed methapyrilene had an average duration of protection of 6.5 hours, compared to an average of 5.5 hours duration of protection with a solution of methapyrilene hydrochloride. However, the difference was not statistically significant as indicated by the Fisher "t" test.

The results of this research indicate that a sustained release of methapyrilene taken orally may be accomplished by the use of sulfonic acid cation exchange resins, and that the rate of release may be controlled by the proper selection of the degree of cross-linkage and particle size of the resin. Microfilm \$2.00; Xerox \$5.40. 110 pages.

THALLOTOXICOSIS

(L. C. Card No. Mic 59-2497)

William Bernard Stavinoha, Ph.D.
The University of Texas, 1959

Supervisor: Professor George A. Emerson

A rapid, sensitive method for assay of thallium in urine samples utilizing dithizon extraction and estimation on the Beckman DU spectrophotometer with flame attachment has been developed.

The daily thallium excretion of six patients with thallotoxicosis was followed and found to be quite variable both day to day and even hour to hour. The clinical condition of the patient and the amount of thallium ingested was found to be only roughly mirrored in the daily excretion of thallium in the urine.

The effect of various forms of therapy such as the use of potassium edathamil, charcoal and dithizon was measured and it was found that no unusual change in the excretion of thallium occurred. Dithizon, although it does not increase the excretion of thallium, was found to be the most effective antidote tested in thallotoxicosis, but this compound must be used with caution because of its potential diabetogenic activity.

The efficacy of various compounds such as sulfhydryls, mercaptoamines, and chelating agents in protecting mice against an LD₅₀ of thallium sulfate was evaluated. The sulfhydryl compounds generally exerted a moderate protective action, and the mercaptoamines were less predictable; many were almost inactive and some, such as AET and APT, were highly active. AET and dithizon were found to be the most active compounds in these tests. Both of these compounds protected approximately 60 percent of the poisoned mice even when given in a single dose 24 hours after the thallium sulfate. On the basis of these experiments, AET seems to merit clinical trial for treatment of thallotoxicosis.

Increased protein level in the diet of rats was found to increase the toxic dose. Experiments that were carried out with diets supplemented with 1 percent cystine and 0.6 percent methionine indicated that no simple correlation existed between the cystine and methionine levels in the diets and the protective effect of the diet. Although

increased levels of methionine and cystine seem to increase the protective activity of the diets, there may be other factors that are as important. Purina Laboratory Chow and Melsa Pro-60 were found to be the most protective diets for rats.

Microfilm \$2.00; Xerox \$6.00. 123 pages.

**A STUDY OF THE EFFECTS OF VARIOUS
PHYSIOLOGICAL, PHARMACOLOGICAL AND REFLEX
ACTIONS ON THE CORONARY CIRCULATION**

(L. C. Card No. Mic 58-3381)

James W. West, Ph.D.
University of Pennsylvania, 1958

Supervisor: Dr. Carl F. Schmidt

The physiology and pharmacology of the coronary circulation is still incompletely understood in spite of extensive studies by a variety of techniques. One reason for this is the fact that those methods which might provide decisive information have in common the shortcoming that they require more or less extensive departures from the normal state. Attempts were made to minimize or circumvent the shortcomings wherever possible without sacrificing the advantages of close approximation to the intact state.

In these studies the effects of chronically altered physiological states (renal hypertension, coronary narrowing, aortic insufficiency and congestive heart failure), reflexes and local effects of various pharmacological agents (sympathomimetic, parasympathomimetic, ganglion stimulating and musculotropic) on the coronary circulation were investigated.

Mongrel dogs were anesthetized with morphine in combination with chloralose or Dial-urethane and/or pentobarbital sodium.

The methods employed were: (a) nitrous-oxide coronary sinus catheterization technique (coronary blood flow), (b) direct Fick (cardiac output, and (c) selective coronary artery catheterization combined with each of the following: (1) coronary sinus cannulation (coronary blood flow), (2) Walton strain gauge (myocardial contractility), (3) ECG, (4) coronary artery cannulation and perfusion and (5) angiography (roengenological and cinematographical). In addition, measurements were made of systemic arterial blood pressure (damped mercury, Lilly, Sanborn and Statham manometers), pulmonary arterial and atrial pressures (water-or electro-manometer), respiration (pneu-

mograph and Tissot spirometer), total peripheral resistance, coronary resistance, oxygen content and saturation of the arterial and coronary venous blood, coronary oxygen utilization, R.Q. of the heart and the myocardial efficiency.

The data was obtained in several different animal preparations with intact chest, except the experiments on myocardial contractility, which were performed in the open chest animal.

The results demonstrate the following: (a) in renal hypertension the coronary blood flow and cardiac oxygen consumption were not altered on a unit weight basis of myocardial tissue compared with normal dogs, but total flow was increased only to the extent that myocardial hypertrophy occurred. Coronary resistance increased above the normals. Specific circulatory changes were observed in relation to the duration and severity of the hypertension. If chronic anemia occurred in renal hypertension, the coronary blood flow was increased on a unit weight basis as well as on a total weight basis (extent of myocardial hypertrophy) and the oxygen uptake was also increased. Protoveratrine produced a therapeutically beneficial effect in renal hypertension by lowering the elevated arterial blood pressure, maintaining cardiac output essentially unchanged and decreasing cardiac work proportionally to the decrease in cardiac oxygen consumption; (b) dogs with coronary narrowing appeared normal at rest but exhibited a decreased capacity to respond to an anoxia test; (c) in chronic compensated aortic insufficiency the coronary blood flow and cardiac oxygen consumption were increased on a unit weight basis as well as on a total weight basis; (d) in animals with single (hypertension, aortic insufficiency, coronary narrowing) and multiple (hypertension with aortic insufficiency or coronary narrowing with aortic insufficiency) lesions bordering on heart failure, ouabain showed little beneficial effects; (e) in normal dogs, intracoronary arterial injections of nicotine elicited parasympathetic, sympathetic and Bezold-Jarisch responses, with no evidence of coronary vasoconstriction, but dilatation; (f) the sympathomimetic amines isoproterenol, levarterenol, epinephrine, epinine, metaraminol, mephenteramine, and phenylephrine were all found to increase coronary blood flow, myocardial contraction, rhythmicity and also altered the ST-T wave complex. Methoxamine either decreased flow or produced no effect on flow and had no positive inotropic or chronotropic effect. In animals with myocardial damage accompanied by hypotension, norepinephrine was more effective than methoxamine in improving the condition of these animals and (g) following coronary arterial perfusion and injection of various agents coronary arterial constriction, dilatation and coronary inhibitory reflexes as well as intrinsic responses were demonstrated. Microfilm \$6.65; Xerox \$23.00. 522 pages.

PHILOSOPHY

ON THE EPISTEMOLOGICAL FOUNDATIONS OF PROBABILITY

(L. C. Card No. Mic 59-1064)

Salvatore Cannavo, Ph.D.
New York University, 1956

Adviser: Milton K. Munitz

A number of general considerations from the viewpoint of formalization and application serve to indicate how the limit-frequency version of the empirical conception of probability can, for empiricism, provide the single-concept basis of a materially relevant theory of probability.

The formalization of probability is carried out most effectively in the abstract, axiomatic mode of exposition which affords the advantages of: (1) separating, logically, the problem of defining probability from those considerations which are primarily of a logico-mathematical concern; and (2) sharpening the crucial distinction between derived probabilities which are computed from given ones by means of the calculus, and initial probabilities which on the basis of some assumed definition of probability are obtained quite apart from the calculus and without the foreknowledge of any other probabilities.

The historically significant alternative to the empirical conception which construes probability as an empirical attribute of material occurrences, is the logical conception which construes probability as a logical relation between meanings. It is not clear on the logical theory, however, how the bearing of any postulated logical relation on future events can be established without invoking a priori criteria, a recourse which is unacceptable for a genuine empiricism. What is more, in demanding of probable prediction a so-called "degree" of certainty based on some purely logical explication of evidence, inductive theories of this kind blur a fundamental distinction of kind (rather than of degree) between the knowledge of established fact and the problematic assertibility of predictions. A failure to distinguish between these two modes of warranted conviction regenerates the well-known historic difficulties that were decisively argued by Hume in connection with inductive inference.

The limit-frequency conception of probability is strongly suggested (though by no means entailed) by the arithmetic of aggregates and by the fundamental uncertainties which profoundly characterize all empirical determinations. The notion of infinite convergence may be given empirical significance by prescribing for any application the practical limits within which convergence statements may be considered verified. This finitization of convergence is familiar in all material applications of the infinitesimal calculi. It is recognized, also, that as empirical determinations, probabilities are themselves subject to probability qualifications. It is nevertheless possible to make theoretical accommodations for such higher-level probabilities without succumbing to regressive difficulties.

The ascertainment of any probability on the limit-frequency conception reduces ultimately to the a posteriori mode of determination by statistical enumeration. Initial probabilities are ascertained by means of the Rule of Induction which prescribes that the relative frequency observed for the given portion of a sequence be proposed as the limit of convergence for the entire sequence. Derived probabilities, on the other hand, are computed from given probabilities by means of the probability calculus. On the limit frequency interpretation, however, the formulas of the abstractly axiomatized calculus are rendered tautologous. As a result derived probabilities are no more than tautological transformations of given probabilities which latter must ultimately reduce to initial probabilities or other equivalent, statistical information. Probabilities of higher-level may be determined as initial probabilities by an enumeration of instances of lower-level probabilities played from sequence to sequence on the second level, sequence-lattice to sequence-lattice on the third level, and so on for mounting levels; or they may be derived from such probabilities by means of the probability calculus. As in the case of primary (i.e., first-level) probabilities, therefore the determination of higher-level probabilities (probabilities of probabilities) requires the introduction of no new probability concept; the a posteriori mode of determination by means of the rule of induction, together with the tautological calculus of probabilities, are entirely sufficient. There is, therefore, no purely a priori determination of probability on the empirical theory here in point.

This manner of analysis may be seen to yield the chief modes of responsible usage and established statistical technique. Of particular interest in this respect are the probabilities of scientific hypotheses. Such hypotheses, it is urged, may, without fundamental violence to significant usage, be interpreted statistically. Accordingly, hypotheses are construed as expressing probability (rather than necessary) relations which are interpreted in terms of sequences of confirmation-instances. This makes the probability of an hypothesis a second-level metric computable either, directly, as an initial probability by enumerating from sequence to sequence for a whole class of hypotheses, or, if the relative frequency of past confirmations is known, as a derived probability (indirect inference) by means of Bayes' theorem. In this latter case the desired probability is an inverse probability whose computation is based on a knowledge of the antecedent probabilities which must ultimately be determined a posteriori as initial, second-level metrics.

It is readily shown how similar accounts may be given to render the appraisal of hypothetical probability metrics and distributions as well as of any general inductive method that might be postulated for the determination of probabilities. In like manner a number of established criteria for gauging the cogency of data may be assimilated to the limit-frequency view. These criteria are generally listed as the quantity, logical proximity, and uniformity of data, and are often assumed with a priori gratuity by

authors on probability. On the present analysis, however, the first criterion is established with the help of Bayes' theorem, presupposing a number of conditions which may be checked for, *a posteriori*. The second and third criteria are also brought under the present account in terms of past success-frequencies for reference classes with high degree of uniformity and close, logical proximity to the event in question.

On the account given, empirical knowledge is reconstructed as a system of probabilities of mounting levels with each probability metric, in general, appraised by one of higher level. At some point, depending on the available statistics, the hierarchy ends with an unappraised probability which is itself determined by the Rule of Induction. The epistemological status of the entire chain of determination rests therefore on two points of consideration, namely, the justification of the Rule of Induction and the appraisive role of higher-level probabilities.

Though at the time they are issued, the predictive proposals prescribed by the Rule of Induction are not known in any factual or analytical sense of knowing, there is nevertheless, an important problematic sense in which such determinations may be said to be warranted, and therefore, cognitively assertible. This assertibility rests on the logically demonstrable fact that, if the future portion of any empirical sequence does in fact converge in the practical long-run, then the persistent use of the Rule of Induction for expanding, observed portions of the empirical sequence must in such long-run lead to success. This follows immediately from the very notion of convergence.

Higher-level probabilities are measures of long-run success with respect to the lower-level determinations which they qualify, and are assertible with the justification that has just been urged for the Rule of Induction on which, like all other probabilities, their ascertainment ultimately rests. The correction of lower-level proposals by higher-level appraisals, however, possesses a decided logical advantage over a method of unappraised determinations on the primary level. This advantage accrues from the demonstrable fact that, if all proposed limits exist, the higher-level determinations may converge earlier (and never later) than primary ones. The hierarchy of appraisals therefore provides the corrective machinery for achieving, where possible, an earlier long-run success.

In conclusion, the foregoing considerations are calculated to re-affirm the empirical conception of probability (explicated as a statistical limit of convergence) with reference to, -- its adequacy as a basis for an empiricist philosophy of empirical knowledge; its accord with all significant usage; and its fulfillment of these demands without the introduction of any fundamentally different conception of probability. The expressed viewpoint assuredly presupposes the undemonstrability (so decisively argued by Hume) of any necessity in inductive inference. Nevertheless, it means to allow (as Hume never did) that the methodological warranty of predictive probabilities as here considered does provide the basis for restoring their indispensable role in material production and, in the guidance of practical life.

Microfilm \$4.40; Xerox \$14.80. 341 pages.

PHYSICS

PHYSICS, GENERAL

GALVANOMAGNETIC PROPERTIES OF LEAD SULFIDE, LEAD SELENIDE, AND LEAD TELLURIDE BETWEEN 4.2°K AND ROOM TEMPERATURE

(L. C. Card No. Mic 59-1886)

Robert Stephen Allgaier, Ph.D.
University of Maryland, 1958

Supervisor: Roald K. Wangsness

The Hall coefficient and resistivity have been measured on 29 single crystals of lead sulfide, lead selenide, and lead telluride between room temperature and 4.2°K. Mobilities were calculated from these data. Magnetoresistance measurements were also made on many of the crystals, mostly at 77.4° and 4.2°K.

The conventional dc method was used to make the measurements. Sample currents of about 10 milliamperes and magnetic field strengths up to about 4300 gauss were used. The sample current was always parallel to a cubic axis of the crystal, and the magnetic field directions were confined to the plane formed by the current axis and another cubic axis.

The Hall coefficient was approximately constant over the entire temperature range investigated. Carrier concentrations calculated from the Hall data were almost always of the order of 10^{18} per cm^3 . A slight decrease in the Hall coefficient with decreasing temperature was ascribed to a change from classical to degenerate statistics. A small low temperature increase in the Hall coefficient of the lead telluride crystals was apparently due to the capture of some of the carriers by shallow localized energy levels.

The average room temperature mobility for n-type natural PbS crystals was 434 $\text{cm}^2/\text{volt-sec}$; the averages for n- and p-type synthetic material were 556 and 608 (PbS), 1023 and 927 (PbSe), and 1623 and 753 $\text{cm}^2/\text{volt-sec}$ (PbTe).

Between room temperature and about 50°K, the mobility behavior was essentially the same for all samples of a given material and carrier type. This behavior can be approximated by $\mu = \mu_0 T^{-n}$, where n is a constant for each sample with a value between 2.0 and 2.4. Below 50°K, the mobility curves turned gradually toward the horizontal in a manner resembling the residual resistance phenomenon observed in metals. A simple experiment suggested that this levelling off was due mostly to scattering

by dislocations. The mobility values varied widely at 4.2°K, and were not correlated with the carrier concentrations. The lowest and highest mobility values at this temperature were 14,400 and 800,000 cm²/volt-sec.

The mobility behavior between room temperature and 50°K can be approximated by combinations of various theories of polar and non-polar scattering, but because of the lack of information on the band structure of the lead salts, no quantitative comparison was made. The very high mobilities which occur despite the presence of 10¹⁸ carriers can be explained by postulating static dielectric constants in the range 100 to 400, and by using the Brooks-Herring formula (extended to degenerate statistics) or a generalized version of the Johnson-Lark-Horovitz formula. Burstein has calculated a value of 70 for PbS, using a formula of Szigeti, and has suggested that higher values may occur in PbSe and PbTe. It may be possible to explain the high mobilities without a high dielectric constant, by treating these materials as metals rather than as semiconductors. Many metals have carrier mobilities in excess of 10,000 cm²/volt-sec, even though their carrier concentrations are of the order of 10²² per cm³.

The magnetoresistance measurements at 77.4°K obeyed small field theory; i.e., the transverse and longitudinal effect were proportional to the square of the magnetic field, and the magnetoresistance at fixed field strength varied sinusoidally with the angle between current and field. At 4.2°K higher mobilities made small field theory inapplicable, and saturation effects and deviations from the sinusoidal behavior were observed.

The longitudinal magnetoresistance was generally as large or larger than the transverse. The cubically symmetric model having energy ellipsoids along the [111] directions in k-space seems most appropriate, especially for the PbTe data. The simple band model, and the cubic model with ellipsoids along the [100] directions are definitely unsuitable.

Much work remains to be done on the lead salts. Cyclotron resonance and static dielectric constant measurements would be particularly useful in clarifying the results of this thesis. Microfilm \$2.70; Xerox \$9.40. 208 pages.

PSEUDODIPOLAR ANISOTROPY IN CUBIC FERROMAGNETS AT LOW TEMPERATURES

(L. C. Card No. Mic 59-1811)

Stanley H Charap, Ph.D.
Rutgers University, 1959

Major Professor: Peter R. Weiss

The first order anisotropy at low temperatures due to nearest neighbor pseudodipolar interaction is calculated using the improved spin waves of Dyson. The advantage of this method over the usual spin wave theory is that the interaction between spin waves via the exchange is embodied in a binary collision term in closed form. The low lying energy spectrum is found, and in the Bloch T^{3/2} law region for the magnetization, it is shown that the first order anisotropy constant varies as the eighth power of the magnetization. By comparison of the first order anisotropy constant calculated for the absolute zero of

temperature with the experimental value for nickel, the strength of the dipolar interaction is shown to be about 300 times the classical value.

Previous calculations by Van Vleck, Van Peipe, and Tessman are compared with the present work on the ground state. Only the work of Van Peipe accounts properly for the exchange and is in complete agreement with the present investigation. The perturbation scheme used by Van Peipe, which has been criticized, is shown to be rigorously correct, the wave function converging to an exponential form.

Microfilm \$2.00; Xerox \$3.00. 56 pages.

THE SELF ENERGY OF A HELICAL DISLOCATION

(L. C. Card No. Mic 59-2015)

Roland de Wit, Ph.D.
University of Illinois, 1959

A review of dislocation theory is given, which includes Kröner's "continuum theory of dislocations and internal stresses." This theory leads to an energy expression for a dislocation in terms of a double line integral along the dislocation line. For the isotropic case this expression is used to find the self energy of straight, circular, cylindrical and helical dislocations. The connection with magnetostatics is pointed out. The helical dislocation is assumed to have a uniform shape with the Burgers vector along its axis. The axial length of the helix is large compared to its radius and the radius is large compared to the dislocation "cross section", which is of the order of a Burgers vector. For a helix of many turns and arbitrary pitch an expansion in a Fourier cosine series is used. The self energy is found in terms of elementary functions and Kapteyn series of Bessel functions. In the limiting cases of a tightly wound helix (small pitch) and a nearly straight helix (large pitch) simple expressions result, which have a plausible physical explanation. For a tightly wound helix the dominant term represents the contribution from the cylindrical part of the helix, the first order terms represent the influence of the size of the dislocation cross section and the second order terms represent the effect of the axial component of the helix. For the nearly straight helix the dominant terms represent the contribution from the straight screw part of the helix and the second order terms give the effect of the interaction between the turns of the helix. The change in self energy when a return loop is present is also considered. Finally a simple expression is obtained for the case of a helix of less than one turn.

Microfilm \$2.00; Xerox \$6.40. 132 pages.

FACTORS AFFECTING THE FORMATION AND DESTRUCTION OF POSITRONIUM IN MATTER

(L. C. Card No. Mic 59-1897)

Robert Lee deZafra, Ph.D.
University of Maryland, 1958

Supervisor: Dr. E. A. Stern

An experimental study has been made of the various factors influencing position annihilation and positronium formation and annihilation in condensed materials. This has been accomplished by observations of the changes produced in the angular distribution of gamma radiation from the annihilation of electron-positron pairs under varying conditions of temperature, pressure and phase, and in the presence of certain types of impurities. It has been established that the so-called temperature effect on angular distribution is in reality a density effect, as are the phase induced changes discovered here. The materials chosen for a study of the temperature-density effect were Teflon, fused quartz, naphthalene, and water, for which the most comprehensive studies were available of the long (τ_2) lifetime component from positron annihilations. On the basis of evidence found here, and concurrently in other laboratories through a study of lifetime behavior, the underlying cause of the density-temperature effect seems to be simply a variation in the fraction of positrons forming positronium. Some alternate suggestions are examined and found to be unsatisfactory in one respect or another. The water-ice transition has been found to show very interesting properties, marked by the appearance of a very narrow and well defined peak in the ice phase. It is suggested that this is due to a reduction of the zero point energy of positronium caused by expansion of the cavities in which positronium may be trapped. Some anomalies are pointed out in the existing τ_2 intensity, lifetime, and 3γ annihilation rate data as a function of phase change in water. The influence of paramagnetic ions in causing $^3S \rightarrow ^1S$ conversion in positronium by electron exchange has been investigated by observing changes in the angular distribution from water as a function of Co^{++} and Mn^{++} impurity concentration. It is shown that a cross section for the conversion mechanism may be derived from the data, having a value of a few times 10^{-19} cm^2 , with a possible error of about a factor of 10. This value agrees within the limits of error with a tentative value found from lifetime studies of Mn^{++} in water. It is suggested that the relatively small cross section is a result of screening by hydration of the paramagnetic ions. From a study of the effect of NO_2^- and NO_3^- ions in water, evidence is deduced to support the hypothesis, suggested by other investigators on the basis of lifetime studies, that positron compounds are formed with these ions. It is shown that small traces of chloroform in benzene produce a broadening of the angular distribution, suggesting that a strong affinity also exists between positrons or positronium and the chloroform molecule. Finally, evidence is given to show that the free radical diphenyl-picryl-hydrazyl may not produce $^3S \rightarrow ^1S$ positronium conversion as supposed from lifetime studies, but may instead give rise to a positronium compound. Microfilm \$2.00; Xerox \$5.40. 107 pages.

SELF-DIFFUSION IN INDIUM

(L. C. Card No. Mic 59-297)

Jean E. Dickey, Ph.D.
Rensselaer Polytechnic Institute, 1958

Supervisor: H. B. Huntington

Indium is a soft silvery metal having a face-centered tetragonal structure with a c/a ratio of about 1.07, the c -axis being the tetragonal axis. The possibility of an anisotropic effect in the atomic diffusion was investigated by comparing the coefficients parallel (D_{\parallel}) and perpendicular (D_{\perp}) to this axis. Single crystals were grown of material of 99.97% and of 99.995% purity. The crystals were oriented by means of x-ray Laue back-reflection patterns. Radioactive In 114 was plated on the front faces of cylindrical specimens. Since the difference between D_{\parallel} and D_{\perp} was expected to be rather small, the diffusion runs were made with pairs of samples; in this way the uncertainties in time and temperature at a given temperature were the same for both D_{\parallel} and D_{\perp} . Sectioning was done by means of a microtome. The resulting slices of thickness about 6μ were smoothed out, mounted on cellophane tape, and counted directly with a thin-walled Geiger tube.

The data showed D_{\parallel} to be smaller than D_{\perp} with the ratio $D_{\parallel}/D_{\perp} = .75 \pm .05$. No appreciable temperature dependence of this ratio was detected in the range from 44° to 144° C . Q_{\parallel} and Q_{\perp} are therefore approximately equal, with the value $18,750 \text{ cal/mol}$. D_0 (\perp) is then 3.7 and D_0 (\parallel) is 2.7 (cm^2/sec). The accuracy of the data does not rule out a difference $Q_{\parallel} - Q_{\perp}$ of order 600 cal/mol , or less. Operation of two independent vacancy mechanisms (diffusing atom jumping to nearest vacant site in, or out of, its own 001 plane) would give $Q_{\parallel} - Q_{\perp}$ of the same order, or somewhat smaller, for the measured value of D_{\parallel}/D_{\perp} . Various crude estimates of the difference in activation energies for motion of the diffusing atom in the two mechanisms were based on the central force concept and the experimental values of the elastic constants. The calculations gave anisotropies that were much too high and led one to believe that a model which took advantage of the relatively low shear moduli of indium would probably be more realistic than models in which compressive strains play an important part.

Mosaic boundaries were observed in the crystal samples and were suspected of being responsible for a component of fast diffusion at the lower temperatures. It is suggested that indium might be a convenient material in which to make a detailed study of the effect of dislocations on atomic diffusion.

Microfilm \$2.00; Xerox \$6.60. 136 pages

MAGNETIC PROPERTIES OF THE MANGANESE CHROMITE-ALUMINATES

(L. C. Card No. Mic 59-2526)

Palmer Lowell Edwards, Ph.D.
University of Maryland, 1958

Supervisor: Dr. Roald K. Wangsness

The mixed-crystal spinel series $\text{MnCr}_{2-t}\text{Al}_t\text{O}_4$ has been synthesized for values of t from zero to two. X-ray spectrometer patterns show that a single cubic phase is formed and that the cell edge is a linear function of the aluminum substitution. An x-ray study of the ionic distribution indicates that the mixed-crystal series forms an almost-normal spinel series with the tetrahedrally-coordinated A sites occupied by divalent manganese ions and about 5% of the trivalent aluminum ions.

An apparatus was designed and constructed to measure the saturation magnetization and susceptibility of the series from 4.2°K to 300°K. A thick solenoid capable of producing a uniform magnetic field of up to 13,000 oersteds over a working space of about one cubic inch provides a field to saturate the sample under study. An additional set of coils produces a uniform gradient field of up to ± 25 oersted/cm over the working space of the magnetizing coil. A sample located in the magnetizing and gradient fields experiences a force which is measured with a chemical balance adapted for the purpose. The temperature of the sample is measured by using a thermocouple of silver with 0.37 atomic per cent gold and gold with 2.1 atomic per cent cobalt.

The magnetization-temperature curves were obtained for $t = 0.00$ to $t = 1.60$ at intervals of 0.20. These curves have approximately zero slope at absolute zero and exhibit no peaks or compensation points. The saturation moment is $1.16\mu_B$ (Bohr magnetons) for $t = 0.0$ increasing to $1.37\mu_B$ at 0.8, dropping to $1.25\mu_B$ at 1.0. For higher values of t the materials could not be saturated with the available fields. The susceptibility was measured up to room temperature for the samples $t = 0.00, 1.00$, and 2.00. The reciprocal-susceptibility curves possess the hyperbolic shape characteristic of ferrimagnets.

The observed magnetic properties cannot be explained in terms of the Néel theory of ferrimagnetism. The three-parameter Yafet and Kittel model, which neglects the interaction of an elementary sublattice on itself and which Lotgering proposed for manganese chromite, is not satisfactory. The five-parameter model of Yafet and Kittel provides a much better description of the observed magnetic properties although the quantitative agreement between the theoretical and experimental magnetization- and susceptibility-temperature curves is not very good. A part of this, however, is probably due to difficulties in temperature control between 30°K and the Curie point.

Microfilm \$2.00; Xerox \$6.40. 133 pages.

ELECTRON BOMBARDMENT OF SILICON

(L. C. Card No. Mic 59-1622)

Dale Eugene Hill, Ph.D.
Purdue University, 1959

Major Professor: H. M. James

The electrical properties of single crystal silicon have been investigated as a function of bombardment with high energy electrons. In general it has been found that electron irradiation changes the electrical properties of silicon in the direction of intrinsic behavior. Information regarding the bombardment-introduced levels was deduced from two types of experiments. First, measurements of the initial carrier removal rate were carried out at 273° K for samples with widely different carrier concentrations. The second type of experiment involved the measurement of the temperature dependence of resistivity and Hall coefficient at different stages of the bombardment.

These experiments have shown that the most numerous irradiation-introduced levels lie close to the band edges; less abundant, deeper bombardment levels also exist. Bombardment-produced levels were found at 0.03 ev, 0.17 ev and 0.4 ev below the edge of the conduction band. With 4.5 Mev electrons, the introduction rates for these levels were 11 cm^{-1} , 0.5 cm^{-1} and 0.05 cm^{-1} , respectively. Bombardment levels were also found at 0.05 ev and 0.3 ev above the edge of the valence band. With 4.5 Mev electrons the introduction rates for these levels were 13 cm^{-1} and roughly 0.3 cm^{-1} , respectively.

Irradiations with 700 Kev electrons indicate the presence of the same defect levels with correspondingly smaller introduction rates.

From an investigation of the irradiation-induced mobility changes for near-degenerate p-type silicon, we find that the rate of introduction of singly charged scatterers is consistent with the maximum removal rate. This indicates that each hole removed from the valence band reappears as a singly charged scattering center. For near-degenerate n-type samples, the mobility changes are much smaller for a similar bombardment, indicating a smaller scattering cross section for the defects.

A comparison of removal rates, for near-degenerate samples irradiated at 273° K, 78° K and 10° K, indicates a smaller damage rate for samples irradiated at lower temperatures. This indicates that the temperature of the lattice exerts some influence on the damage process or on any healing process which may go on at the same time.

Preliminary measurements at lower energies indicate the presence of bulk damage extending down to electron energies of 200 Kev.

Non-equilibrium effects, existing after the bombardment of high resistivity silicon, appear to be due to electronic non-equilibrium conditions brought on by the heavy ionization created by the bombarding particles.

Microfilm \$2.00; Xerox \$5.60. 112 pages.

THEORY OF ULTRASONIC CYCLOTRON RESONANCE IN METALS AT LOW TEMPERATURES

(L. C. Card No. Mic 59-2399)

Terje Kjeldaas, Jr., Ph.D.
University of Pittsburgh, 1959

It has been known for some time that the very large attenuations experienced by high frequency sound waves in pure waves in pure metals at very low temperatures are due to interaction with the conduction electrons. One may therefore expect any magnetic field dependence of the energy absorption by the conduction electrons to be directly reflected in the attenuation.

In the present work, a theoretical investigation is made of the possibility of using the internal electric fields associated with ultrasonic waves in metals as the driving force in cyclotron resonance experiments. The object is thus to obtain an understanding of how measurement of the magnetic field dependence of the attenuation and speed of sound waves may yield information about the electronic energy band structure of a metal.

The configuration investigated is that of a transverse wave propagating parallel to the direction of a uniform external magnetic field. Thus the internal electric field is, like in ordinary cyclotron resonance, perpendicular to the steady magnetic field. The main physical feature which characterizes the ultrasonic experiment and distinguishes it from the usual cyclotron experiment is the fact that the velocity of the electrons on the Fermi-surface is much larger than the speed of sound. As a result the time rate of change of the electric field experienced by a conduction electron depends strongly on its component of velocity in the propagation direction. The effective frequency is given by a Doppler-shift equation. The maximum effective frequency is experienced by electrons moving parallel to the propagation direction. At a given value of magnetic field there will be a group of conduction electrons, of particular value of velocity component, whose effective frequency equals the cyclotron frequency, unless the magnetic field is so large that the cyclotron frequency exceeds the maximum effective frequency. Therefore an absorption edge should be observed upon varying the magnetic field for a fixed sound wave frequency. Moreover, from the nature of the variation with magnetic field in the absorption region, information about the Fermi-surface should be obtainable.

This physical picture is confirmed by calculations for a free electron model of a metal. The interaction between the electrons and sound waves is treated classically and is viewed as taking place via an internal electric field and by scattering modified by the sound wave. The calculation proceeds in three steps:

- a) By means of the Boltzmann equation the electron current is obtained as a function of the internal electric field and of the lattice ion current with the external electric field and the lattice velocity.
- b) Maxwell's equations are used to eliminate the electron current, yielding a relationship between the internal electric field and the lattice velocity.
- c) The force of the electric field on the lattice and that of the external field is included in an acoustic wave - equation for the lattice and the propagation characteristics found.

It is concluded that circularly polarized waves of opposite polarizations have their velocities oppositely affected by a magnetic field, and that plane polarized waves have their plane of polarization rotated.

From calculations with more general band models the nature of the information obtainable about the Fermi-surface is discussed; in particular it is demonstrated that measurement of the absorption edges using single crystals can yield the value of the Gaussian curvature of the Fermi-surface at certain points.

Microfilm \$2.00; Xerox \$3.00. 43 pages.

PROPAGATION OF ACOUSTIC WAVES IN A MEDIUM WITH EXPERIMENTALLY DETERMINED INHOMOGENEITIES

(L. C. Card No. Mic 59-2206)

Stanley Reed Murphy, Ph.D.
University of Washington, 1959

Chairman: Joseph E. Henderson

This paper reports the results of an investigation of acoustic propagation in an inhomogeneous medium in which the index of refraction was determined experimentally. The medium used in these investigations was the water of Dabob Bay located in the state of Washington. The inhomogeneities of interest in this work were the small scale (of the order of a few tenths of a degree centigrade or less) variations in temperature known to exist in natural sea water but not observable on the standard Bathythermograph. Currently accepted descriptions of this thermal "microstructure" are contained in a statistical model in which small "patches", of an average diameter of about one meter, suffer rearrangement in short enough times to allow the application of an ergodic hypothesis in order to describe, statistically, the effect of such a distribution on sound transmission.

A sensitive thermistor probe, capable of resolving 0.01°C , was developed and utilized to determine the detailed structure present in the Bay. Acoustic and electronic instrumentation was constructed which, under pulse operation at 60 kc and with a geometry which eliminated reflections from the boundaries, enabled a study to be made of the effects of thermal microstructure on direct transmission from a point source. The use of buoy stations in the sheltered waters of the bay permitted station-keeping during both the temperature survey and acoustic experiments to better than one foot in depth. The experimental results were as follows:

- (1) No evidence for support of a statistical model of thermal microstructure was found.
- (2) In contrast, it was established that the thermal microstructure of natural sea water exists in well defined horizontal layers having a temperature with respect to the surrounding water of the order of 0.1°C and a thickness of the order of a few feet.
- (3) Acoustic transmission from a point source in the presence of such layers shows a variation in sound intensity, from that of a homogeneous medium, in the vicinity of the layer.
- (4) The magnitude of such variations increases with

range, decreases with the layer thickness, and is stable in space over periods of many minutes.

In addition to the above experimental work a theoretical calculation on the effect of such layers on acoustic transmission was made. In order to obtain a solution capable of numerical analysis, it was necessary to employ a perturbation expansion of the eikonal equations of ray acoustics. A comparison of this theory with the transmission experiments showed agreement, in first order, with the experimental results. Possible improvements on this theoretical method are discussed with the view of obtaining a validity condition.

Microfilm \$2.00; Xerox \$5.00. 98 pages.

A NEUTRON DIFFRACTION STUDY OF CHROMIUM-SUBSTITUTED FERRITES

(L. C. Card No. Mic 59-1920)

Stanley Joseph Pickart, Ph.D.
University of Maryland, 1958

Supervisor: Professor Roald K. Wangsness

Certain binary transition metal oxides with the crystal structure of spinel exhibit unusual magnetic behavior. The magnitude of the spontaneous magnetization at 0°K is less than the total ionic moment, and its temperature variation is in some instances not predicted by the Weiss molecular field theory. Many features of these compounds have been explained by Néel with the introduction of a two sublattice model into the theory; subsequently, Yafet and Kittel extended his calculations to include ordering within the sublattices. In the present investigation, the technique of neutron diffraction has been applied to the investigation of cases where these theories are thought to diverge, specifically the chromium-substituted ferrites with the chemical formula $MFe_{2-t}Cr_tO_4$, where M represents the divalent ions Ni and Mn and the compositional parameter t equals 1.0 and 1.5.

The structural parameters, which specify the cation positions in the lattice and the deviation of the coordinating oxygen anions from ideal symmetry, have been derived from these measurements; these are necessary to predict the total value of the magnetization expected from various models and to discuss the type of binding in the lattice. Moreover, because of the magnetic interaction between the neutron and the cation spin, the diffraction data give the individual moment of each sublattice and its temperature dependence, results which cannot be determined by conventional magnetization measurements.

The experiments were performed on a double crystal powder spectrometer at the Brookhaven reactor. In order to realize the desired range of temperatures, a liquid helium cryostat was constructed which incorporated an electromagnet for separating the nuclear from the magnetic scattering.

The results of this investigation can be briefly summarized as follows. The manganese compounds have the "normal" spinel structure, i.e., the divalent manganese occupies the tetrahedrally coordinated lattice positions; in the nickel compounds, the chromium can be assigned to the octahedrally coordinated positions. The magnetic

scattering can be fitted by a model in which the tetrahedral and octahedral moments are antiparallel, as Néel suggested, but with the octahedral moment lower in most cases than the sum of the ionic moments occupying these sites. There is no evidence for ordered triangular spin configurations of the kind proposed by Yafet and Kittel. The temperature dependence of the individual sublattice magnetizations, as well as the effect of an applied field upon the coherent magnetic intensities, has been determined for several of the compositions studied.

Microfilm \$2.00; Xerox \$4.40. 83 pages.

STUDY OF THE CONDUCTION BAND OF GERMANIUM BY PIEZORESISTANCE MEASUREMENTS

(L. C. Card No. Mic 59-2404)

Michael Pollak, Ph.D.
University of Pittsburgh, 1959

Piezoresistance has been measured as a function of temperature in n-type germanium specimens with donor concentrations between $6 \times 10^{15} \text{ cm}^{-3}$ and $3 \times 10^{19} \text{ cm}^{-3}$. The results obtained can be explained on the basis of the accepted multivalley model, provided that statistical degeneracy is taken into account. The degeneracy effect can be interpreted by assuming that there are four valleys in the conduction band. The data are consistent with the assumption that there are no appreciable changes in the effective mass, deformation potential constant, and mobility anisotropy factor. No effect due to the (100) valleys is detected, showing that these valleys are at least 0.11 eV above the edge of the conduction band.

A method for measuring piezoresistance effects in semiconductors is described. The principal sources of error of the usual steady stress method, namely drift of the temperature and sample current, and semiconductor noise are avoided by using a 29 cps alternating stress. The method, because of high sensitivity, is particularly suitable for low resistivity material. It is, however, not applicable to materials with extremely high resistivity. The piezoresistance constants directly measured are adiabatic.

A method for growing single crystals of heavily doped n-type germanium is also presented. Among antimony, arsenic, and phosphorus, the last is found to be the most suitable doping agent.

Microfilm \$2.00; Xerox \$4.20. 76 pages.

ELECTRON SPIN RESONANCE OF ULTRAVIOLET IRRADIATED ORGANIC COMPOUNDS

(L. C. Card No. Mic 59-1921)

Charles Patton Poole, Jr., Ph.D.
University of Maryland, 1958

Supervisor: Professor Roy S. Anderson

The 9000 Mc electron spin resonance spectra of over 100 ultraviolet-irradiated organic compounds maintained

at 77°K have been recorded at a g-factor of two. The mechanism of radical production entails the absorption of the photon by a pi electron and the subsequent rupture of a nearby bond. Unsaturated hydrocarbons show well-resolved, symmetric, evenly spaced hyperfine structure of three to seven lines. Aldehydes are characterized by a strong singlet attributed to the alkanoyl radical on which there is superposed weaker, time-decaying multicomponent structure attributed to alkyl radicals. Nitrogen-containing compounds exhibit triplet structure resulting from the nuclear spin of nitrogen. Other classes of compounds are discussed, including ketones, esters, acids and halides. In general the resonances obtained are characteristic of the class of compound irradiated, and in many cases the radicals may be identified by the spacing and intensity ratios of the hyperfine structure components. Only hydrogen atoms in positions α and β relative to the unpaired electron contribute to the hfs, and they have approximately equal hyperfine coupling coefficients. Hyperfine line widths and component separations are about two milliwelbers per square meter. Line widths calculated from dipole-dipole interaction with surrounding hydrogen atoms agree with the observed widths. While most radicals are stable for weeks at 77°K, some change or decay with time, indicating secondary reactions. Hydrogen atoms and methyl radicals, which are preferentially formed from hydrocarbons, are highly mobile and have not been detected because of their rapid recombination or reaction with their environment. Microfilm \$2.45; Xerox \$8.60. 186 pages.

THE EFFECT OF CORRELATION ON THE PROPERTIES OF A DEGENERATE ELECTRON GAS

(L. C. Card No. Mic 59-1922)

John Joseph Quinn, Ph.D.
University of Maryland, 1958

Supervisor: Dr. Richard A. Ferrell

Interactions in a degenerate electron gas are studied by considering the self-energy of particle impurities in the system. The self-energy results as in quantum electrodynamics from the action of the proper field set up by a charged particle back on the particle; the Feynman space-time approach to electrodynamics is employed in the self-energy calculation. The Feynman propagator, which takes the particle from one point in space-time to another, is derived. It is found that a slight but essential change in the particle propagator is needed to allow for exchange effects when the particle impurity is an additional electron in the degenerate electron gas. This gives the electron gas a dual role: it acts as a dielectric medium which can be polarized and also as a vacuum from which electron-hole pairs can be created and undergo exchange with incident electrons. The propagator for the effective potential set up by the impurity in the electron gas, considered as a dielectric medium, is also discussed. This polarization propagator depends on the wave-number and frequency dependent dielectric constant for the electron gas. The dielectric constant for the system is studied in some detail, starting with a derivation of the static dielectric constant and its application to the problem

of polarization by a static impurity. By a slight generalization of the methods used in treating the static impurity, the wave-number and frequency dependent dynamic dielectric constant for the electron gas is determined.

Using the propagators, the expression for the self-energy of a particle impurity can be written down. The polarization energy of the impurity is then just the difference between its self-energy in the electron gas and its self-energy in vacuum. A few simple calculations of the polarization energy produced by distinguishable impurities lay the groundwork for the more interesting problem of electron self-energy. It is found that the electron self-energy has both a real and an imaginary part and can be thought of as an effective optical potential similar to those in nuclear physics. For momenta less than the Fermi momentum, the optical potential is simply the negative of the potential of a hole in the Fermi sea. The imaginary part of the optical potential for an electron of momentum p is proportional to $(p/p_0 - 1)^2$ (where p_0 is the Fermi momentum), and gives rise to a damping of one-electron states outside the Fermi sea. The value of the real part of the optical potential as well as its derivative with respect to momentum are finite at the Fermi surface. The derivative gives a correction to the electron specific heat which agrees with the results of Gell-Mann. The sum of the real part of the optical potential and the kinetic energy $p^2/2m$ is just E_S , the negative of the separation energy. The total ground state energy per particle, $g(r)$, is quite simply related to E_S , and the expression obtained for $g(r_S)$ is found to agree with the results of other investigators. Microfilm \$2.00; Xerox \$6.80. 144 pages.

A NEW POSTULATIONAL FOUNDATION OF QUANTUM MECHANICS

(L. C. Card No. Mic 59-2473)

Richard Scalettar, Ph.D.
Cornell University, 1959

This work embodies a reformulation of the postulational foundation of quantum mechanics stemming from the investigations of von Neumann and Birkhoff into the relations among the properties of atomic systems, the linear sub-spaces of Hilbert space, and lattice theory.

It is shown that the fundamental properties of quantum mechanical systems and the relations among these properties may be given operational definitions in probabilistic terms by considering measurements on an ensemble of identically prepared systems. No assumption need be made concerning the compatibility of such experimental propositions in formulating these definitions. The relations operationally defined are those which, in the conventional formulation of quantum mechanics, are specified by the abstract assertions that the intersection of two linear sub-spaces of Hilbert space, the linear sub-space spanned by two such sub-spaces, and the orthogonal complement of a linear sub-space, are all associated with properties of a physical system. Direct physical content is given to these results of quantum mechanics and by an appropriate choice of assumptions, the most important of which is the ideal measurement postulate, the above concepts and their consequences may be derived from the

characteristic physical features of quantum mechanics. The latter, to which precise definition is given in this work, are its probabilistic nature, the non-classical relation between the existence and non-existence of a property for a given system, and the inability simultaneously to determine all such properties for the system.

A mathematical consequence of this investigation is the proof of the fact that, under certain reasonable physical assumptions, the set of experimental propositions constitutes a lattice. The mathematical definition of the compatibility of experimental propositions, formulated in terms of the lattice structure, leads to the desired physical conclusion that, for compatible properties, measurement of one does not disturb previously obtained knowledge of the other. The existence of incompatible properties shows that the lattice is non-distributive, which is an abstract statement of an essential difference between quantum and classical physics.

It is shown that a natural physical definition of the state of a quantum-mechanical system leads to the association of a state with indecomposable properties. These are defined by the fact that they are quantum mechanically implied by no other non-trivial property. The state properties are incompatible if and only if the determination of one such does not force the conclusion that the other does not exist for the system. The experimental fact that such indecomposable properties are found in nature is an essential manifestation of the non-distributivity of the lattice of experimental propositions of quantum physics.

By means of two assumptions of a rather less well-motivated nature, the lattice of experimental propositions may be forced into an isomorphism with the set of linear sub-spaces of Hilbert space. The investigations in the earlier part of this work indicate that this is probably not essential for retaining many of the basic features of quantum physics and possible directions for certain variants are indicated. Microfilm \$2.00; Xerox \$4.40. 84 pages.

COLLOIDS AND COLOR CENTERS IN BaO CRYSTALS

(L. C. Card No. Mic 59-2698)

Stanley Ted Sekula, Ph.D.
Cornell University, 1959

An investigation of the properties of BaO single crystals additively colored with excess Ba was undertaken. A vacuum R. F. furnace for the additive coloration of BaO crystals was constructed which allows for a variation in the quenching rate of the crystal. The extremely hygroscopic nature of BaO required that special precautions be employed for the preparation of the crystals for all measurements. The use of several spectrophotometers made it possible to measure the optical absorption in the range .34 microns to 25 microns. Freshly cleaved surfaces of untreated and colored BaO crystals were studied with the electron microscope. Dark field optical microscopy was also utilized for examination of the crystals for imperfections. Low frequency dielectric measurements were made using a substitution method with the aid of a Q-meter in the frequency range 50KC/sec. to 50MC/sec.

Optical absorption studies of untreated BaO revealed

secondary reststrahl absorptions at 21.0 microns and 3.1 microns although identification of the latter is less certain. An absorption band at 2.8 microns was identified as being due to a hydroxide layer. Crystals heat treated in Ba vapor exhibited color absorption bands at 2.1 e.v. and 1.1 e.v. In addition, an infrared absorption which increased monotonically with wave length, was found to be proportional to the square of the wave length from 1.5 microns to 5.0 microns. The temperature dependence of the color bands and the infrared absorption was investigated in the temperature range 200°C to -190°C. The infrared absorption decreased as the temperature decreased, but the temperature dependence was not as apparent for the color bands since the infrared absorption tail in the visible affected strongly the behavior of the color bands. Dielectric constant and loss measurements revealed that the apparent dielectric constant and loss of the colored crystals were approximately 20 times larger than those of untreated crystals. The dielectric loss of colored crystals was shown to decrease as the temperature decreased. Dark field microscopy showed that large metal colloids were dispersed in a nonrandom fashion in untreated and colored crystals. These colloids were square shaped and although an array of these would lie along some curved path, the edges of every colloid were oriented along the 100 direction of the crystal. Complete bleaching of a colored crystal at 600°C resulted in an increase of large colloidal particles in the crystal. Electron microscope studies of cleaved BaO surfaces showed that colloids which varied in size from 400 Å to 3000 Å were present in colored BaO crystals. However, the presence of colloids could not be established as arising from the coloration process because of the variation in quality of the untreated crystals.

Two models consistent with the infrared observations and previous conductivity measurements are discussed: a free charge carrier mechanism in conjunction with d.c. barriers and a colloidal metal model. The temperature dependence of the infrared absorption is analyzed in terms of both models. The temperature dependence of the 2.1 e.v. color band is discussed and the possibility of the identification of the source as atomic centers or colloidal particles is considered. A possible relationship between the color centers and the infrared absorption is also treated. It is concluded that an interfacial polarization mechanism is responsible for the increase in the complex dielectric constant of BaO after a coloration treatment. The free carrier-barrier model and the colloidal model are examined for possible explanations of this phenomenon. The observations of clear and colored crystals with electron and optical microscopy are analyzed in the light of the other investigations.

Microfilm \$2.20; Xerox \$7.80. 166 pages.

THE IMAGINARY PART OF THE OPTICAL MODEL POTENTIAL FOR NEUTRON INTERACTIONS WITH NUCLEI

(L. C. Card No. Mic 59-2699)

Gordon Lionel Shaw, Ph.D.
Cornell University, 1959

The Brueckner nuclear many-body theory is modified so that it can be applied to the problem of dealing with

quasi-stationary excited states. In this manner we are able to treat low energy (several Mev) neutron interactions with heavy nuclei taking into account the identity of the incident neutron with the nucleons in the nucleus.

The imaginary part, W , of the single-particle potential acting on the incident neutron is calculated. W is the imaginary part of the complex potential in the optical model of Feshbach, Porter, and Weisskopf. The computations are done by evaluating the interactions of the incident neutron with each target nucleon which lead to a real two-particle excited state of our model; exact treatment of these pair interactions was made possible through the use of some G matrix elements determined by Brueckner and Gammel. The effect of the rest of the nucleons was included through the self-consistent single-particle potential acting on each state and through the limitations imposed by the exclusion principle on the states to which the pairs of particles could scatter. Higher order corrections are then considered.

W was determined in the surface region by assuming that the potential acting on the incident neutron at a distance, r , from the center of the nucleus is that which it would see if it were immersed in an infinite nucleus having a uniform density equal to $\rho(r)$. The results, which give us W as a function of r and the kinetic energy, E_n , of the incident neutron, indicate a surface absorption potential: W has a constant central region and reaches a peak, of greater than twice the central value, in the surface. The values of the quantity $S(E_n) = \int W(E_n, r) d^3r$ that we predict are in agreement with the phenomenological potentials which have been used in the optical model. The shape of W is most nearly matched by the potential of Bjorklund, Fernbach, and Sherman.

An investigation is made of the next step after the compound state is formed. The possibilities of direct inelastic particle emission, compound elastic scattering, and further sharing of energy in the formation of a compound nucleus are considered. For heavy nuclei, compound nucleus formation dominates; for light nuclei ($A = 50$ or lower), there may be fluctuations of the cross section related to two-particle states.

Microfilm \$2.00; Xerox \$5.60. 111 pages.

POLARIZATION OF THE ELECTRON GAS IN METALS BY SUBSTITUTIONAL IMPURITIES

(L. C. Card No. Mic 59-1828)

Benjamin David Silverman, Ph.D.
Rutgers University, 1959

Major Professor: P. R. Weiss

The ground state energy of the system of impurities and conduction electrons in a metal has been obtained in the high electron density limit. The procedure used is an extension of the Wentzel method applied to a reduced Hamiltonian which includes an electron-impurity interaction. It is reduced in the sense that the coulomb interaction between electrons and the electron-impurity interaction are only effective in raising an electron in a state below the Fermi level to one above and vice versa. The

ground state energy is then obtained by a canonical transformation. The shift in energy of the ground state of the electron gas due to the introduction of the impurities is quadratic in the electron-impurity matrix element. Higher order processes in this matrix element do not contribute since they are represented by unlinked diagrams. Considering this shift in the ground state energy expandable in powers of r_s , a measure of the interelectronic distance, we show the leading or lowest order term to go as $r_s^{5/2}$. All processes omitted in the perturbation expansion are shown to contribute to higher powers in r_s . We have assumed the impurity locations to be random.

Microfilm \$2.00; Xerox \$3.60. 61 pages.

A STUDY OF THE ROTATIONAL SPECTRA OF SOME OF THE TRI-HYDRIDES OF THE FIFTH GROUP OF ELEMENTS OF THE PERIODIC TABLE

(L. C. Card No. Mic 59-2324)

Richard Eugene Stroup, Ph.D.
The Ohio State University, 1953

The far infrared spectrograph at The Ohio State University has been used to obtain the rotational spectra of phosphine, arsine, deuterated ammonia, deuterated phosphine, and deuterated arsine. The status of the rotational spectra of each of the members of this family of molecules and the additions made by this work are given in Table I. The spectra of these molecules in the ground vibrational state are shown both in tabular and graphic form.

TABLE I
ROTATION LINES OF THIS FAMILY OF MOLECULES

	Number of Lines Previously Reported	Number of Lines Reported Here
NH ₃	15	0
ND ₃	6	14 (8 additional ones)
PH ₃	4	18 (14 additional ones)
PD ₃	0	11
AsH ₃	0	13
AsD ₃	0	10
SbH ₃	0	0
SbD ₃	0	0

Figure 1 shows a plot of two PD₃ records along with a calculated PD₃ spectrum and a plot of a PH₃ spectrum. In a sequence of this type it seemed possible to assign tentatively some of the lines to the partially deuterated phosphines, PH₂D and PHD₂. The lines so assigned are indicated by dots in Figure 1.

Two previously unpredicted series of lines were found in the phosphine spectrum, and similar series were indicated in the arsine spectrum. These additional series are

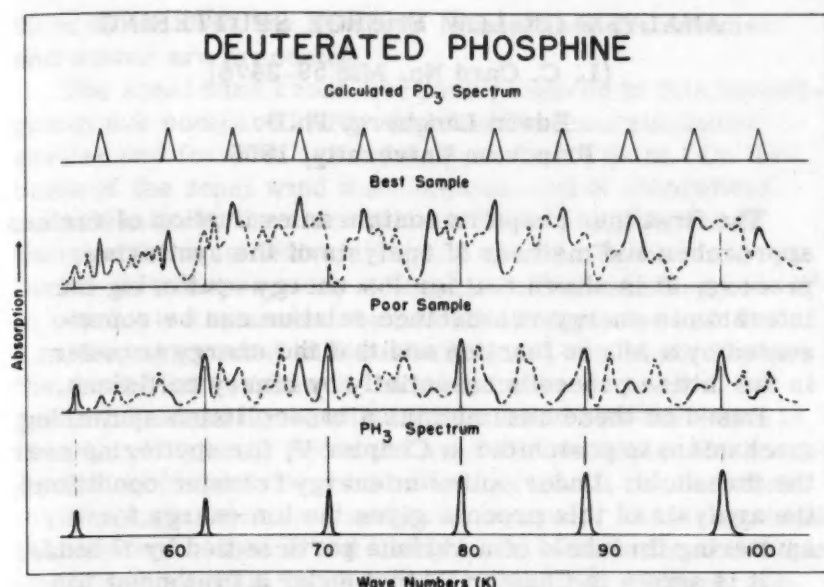


Figure 1

ascribed to rotational transitions occurring while the molecules are in excited vibrational states.

The rotational constants of the molecules, which were obtainable from these data, have been determined for each series of lines for each molecule. These molecular constants are compared with those obtained from the near infrared and microwave data in Table II.

TABLE II
ROTATIONAL CONSTANTS

		$B_{v_1v_2v_3v_4}$			$4D_J$		$4D_{JK}$
		Near Infrared K	Far Infrared K	Microwave K	Near Infrared K	Far Infrared K	Near Infrared K
PH ₃	B ₀₀₀₀	4.453	4.454	4.464	0.000545	0.000421	0.000577
	B ₀₁₀₀		4.57				
	B ₀₀₀₁		4.30				
AsH ₃	B ₀₀₀₀	3.714	3.745	3.738	0.000396	0.000290	0.000475
ND ₃	B ₀₀₀₀	5.109	5.143		0.000736	0.000540	0.000780
PD ₃	B ₀₀₀₀	2.308	2.316	2.315	0.000128	0.000095	0.000137
AsD ₃	B ₀₀₀₀	1.891	1.918	1.903	0.000096	0.000070	0.000112

Microfilm \$2.00; Xerox \$5.00. 100 pages.

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LOW TEMPERATURE SPECIFIC HEATS OF BODY-CENTERED CUBIC CHROMIUM-IRON ALLOYS

(L. C. Card No. Mic 59-2063)

Chuan-Tseng Wei, Ph.D.
University of Illinois, 1959

The specific heat of Fe and a series of eight body-centered cubic Cr-Fe alloys was determined in the temperature range from 1.8° to 4.2°K. The ingots used for the specimens were prepared from electrolytic Cr and Fe flakes in recrystallized alumina crucibles by means of induction melting under helium atmosphere. The ingots were annealed at 1,170°C for at least three days in an

atmosphere of 92% He- 8% H₂ gas mixture with the presence of Mo sheet as a getter, and quenched in water at the end of the annealing period. The coefficient γ of the temperature-linear term in the specific heat was calculated for all the alloys by a least squares method. The γ for Fe of $(12.0 \pm 0.2) \times 10^{-4} \text{ cal mol}^{-1} \text{ deg}^{-2}$ determined by the present work is in agreement with previously reported values. The plot of γ vs electron concentration outside the closed argon core of the various alloys shows a high peak of γ greater than $39.5 \times 10^{-4} \text{ cal mol}^{-1} \text{ deg}^{-2}$ at an electron concentration of 6.38 ± 0.02 electrons per atom. The γ vs electron concentration curve may be extrapolated to $\gamma \rightarrow 0$ near Cr. Various possibilities including the one based on the band scheme for the interpretation of this γ vs electron concentration curve are discussed. The Debye characteristic temperature was calculated for the various alloys investigated from the temperature-cubic term in the specific heat equation. Because of the high values of the electronic specific heat in these alloys, the accuracy with which the Debye characteristic temperature can be determined from the data is not very satisfactory.

Microfilm \$2.00; Xerox \$4.60. 89 pages.

THEORY OF THE ABSORPTION SPECTRUM OF IONS IN SOLUTION

(L. C. Card No. Mic 59-1654)

William James Whitesell, Ph.D.
Purdue University, 1959

Major Professor: Robert L. Platzman

The theory of the absorption spectrum of simple ions in solution is developed from a model which treats the optical transitions as excitation of an outer electron of the ion to a bound state in the field of the residual atom and the surrounding solvent. Detailed treatment is carried out for the aqueous chloride ion.

A one-electron wave function for the initial state is taken from Hartree, and those for the final states are computed numerically from the Schrodinger equation with a potential consisting of the Hartree potential for the chlorine atom added to a modified coulomb potential for the water dipoles.

Energies and oscillator strengths are computed for the first three transitions of the Rydberg series, the oscillator strength for the lowest transition being 0.107, in excellent agreement with the value of 0.10 obtained from the measured absorption spectrum. Additional details and other transitions are also discussed, in part on the basis of the relationship of this spectrum to rare gas spectra.

A few aspects of bromide and iodide spectra are treated. Transition energies for doubly negative ions are discussed in an appendix.

Microfilm \$2.00; Xerox \$3.80. 68 pages.

PHYSICS, ELECTRONICS AND ELECTRICITY

AN IMPROVED METHOD FOR MEASURING OPTICAL EXCITATION FUNCTIONS

(L. C. Card No. Mic 59-2076)

Charles J. Bronco, Ph.D.
The University of Oklahoma, 1959

Major Professor: R. G. Fowler

The cross section for excitation of the 3^1P level of Helium by electron impact as a function of the incident electron energy, (called the excitation function for the 3^1P state), has been investigated by several experimenters in the period 1928-34. Lees and Thieme were the only investigators to obtain results which were independent of the incident electron current. Their measurements however were not shown to be pressure independent. There was agreement in the shapes of their curves with a maximum cross section of $3. \times 10^{-17} \text{ cm}^2$ occurring at 100 ev of incident electron energy.

This was not in agreement with the theoretical maximum predicted by the Born approximation which is $2.6 \times 10^{-18} \text{ cm}^2$. Furthermore the Born approximation is expected to give an overestimate, not an underestimate. Also an analysis performed by Corrigan and Von Engel on recent experimental studies of energy losses of mono-energetic electron beams together with published theoretical excitation functions has estimated the maximum cross section for excitation of the 3^1P to be roughly $2.0 \times 10^{-18} \text{ cm}^2$.

The method described in this thesis was designed around recent advances in experimental technique. A barium impregnated cathode was used for copious electron emission at low temperatures in a narrow energy range. A Westinghouse type ultra high vacuum system was built to insure purity of the working gas. A photon counting technique was adopted using an EMI 6256B photomultiplier tube refrigerated to liquid air temperature. Velocity resolution was designed for 0.1 ev. The gain in sensitivity attained allowed the cross section to be studied at lower pressures and currents.

Linearity of the graph of the $3^1P \rightarrow 2^1S$ transition intensity versus electron beam current showed the 3^1P cross section to be independent of the incident electron current in the range measured. The $3^1P \rightarrow 2^1S$ transition intensity versus collision chamber pressure became linear at pressures lower than $5 \times 10^{-3} \text{ mm}$. The general shape of the pressure curve agreed with that predicted by Phelps, although linearity was not expected until 10^{-3} mm .

The magnitude for the maximum cross section for the 3^1P state was calculated to be $4.8 \times 10^{-19} \text{ cm}^2$. This is two orders of magnitude lower than that predicted by Lees and Thieme. Being an underestimate, the value measured by the method of this thesis is in agreement with the value predicted by the Born approximation. It also agrees with the results of Corrigan and Von Engel within an order of magnitude. The excitation function appears to rise slowly at first and attain a maximum value at 65 ev.

Microfilm \$2.00; Xerox \$4.20. 79 pages.

ANALYSIS OF LOW ENERGY SPUTTERING

(L. C. Card No. Mic 59-2476)

Edwin Langberg, Ph.D.
Princeton University, 1956

The first four chapters contain an evaluation of various approaches and methods of analysis of the sputtering process. It is shown that for low energy sputtering the interatomic energy vs. distance relation can be represented by a Morse function and that the energy transfer in the lattice proceeds essentially by binary collisions.

Based on these assumptions a two-collision sputtering mechanism is postulated in Chapter V, for sputtering near the threshold. Under optimum energy transfer conditions, the analysis of this process gives the ion energy for a sputtering threshold of a surface particle tied by N bonds.

It is shown in Chapter VI that under a prolonged ion bombardment a surface contains particles with a number of bonds n ranging from a maximum determined by a complete surface to a minimum determined by inaccessible bonds to underlying surface layers.

Based on this information the form of the sputtering yield vs. energy function is derived in Chapter VII, and shown to consist of a parabolic and a linear part. Predicted and experimental Pt-Hg⁺ curves are compared and the agreement found to be excellent.

Two thresholds are defined in Chapter VIII: The lower threshold is the actual intercept of the yield curve, whereas the upper threshold corresponds to the intercept of the linear part of the yield curve. The two thresholds are computed for twenty metals bombarded by the Hg ion. The agreement with experimental values, and the empirical threshold formula due to Wehner is shown to be satisfactory.

Microfilm \$2.00; Xerox \$4.40. 83 pages.

PHYSICS, METEOROLOGY

CIRCULATION IN THE UPPER ATMOSPHERE

(L. C. Card No. Mic 59-946)

Pemmaraju S. Pant, Ph.D.
New York University, 1956

Adviser: Professor B. Haurwitz

The winds between 20 to 100 km elevation at different latitudes in the Northern Hemisphere are critically examined. In order to check the consistence between the observed wind and temperature fields, the temperature distribution is computed from the wind field with the aid of the rocket mean pressure data and under the assumption that the wind field is geostrophic. The temperatures thus obtained are found to agree with the direct observations. Thus the observed wind and temperature distributions are shown to be consistent. Possible causes of some of the observed seasonal temperature changes in different parts of the upper atmosphere are discussed. Tentative temperature cross-sections for the region from

20 to 90 km over the Northern Hemisphere for summer and winter are presented.

The zonal wind cross-sections prepared in this investigation are compared with wind distributions published earlier and found to agree fairly well with them. On the basis of the zonal wind distributions, and of theoretical considerations, the circulation in the mesosphere and thermosphere is derived (Figs. 7 and 8). In the meso-incline in summer, a meridional circulation is suggested in which air rises over the pole and travels toward the equator, associated with easterly zonal winds. In winter the meridional motion in the mesoincline is toward the pole, with westerly zonal winds followed by subsidence in the polar regions. From the available evidence, the meso-decline is found to be a turbulent region. It is concluded that the turbulence is stronger in summer. It is suggested that the turbulence is not likely to exist in the mesodecline over the higher latitudes in winter and that, instead, subsidence will here take place.

A model of meridional circulation in the thermosphere (above 80 km) which fits in very well with the winds in the 80 to 100 km region, is proposed. In arriving at this model, the effect of viscosity is taken into account.

The circulation developed here for the mesosphere agrees well with the model suggested by Kellogg and Schilling (1951). But the circulation proposed here for the thermosphere on the basis of more data, differs considerably from the circulation indicated by the above authors for the region from 80 to 120 km. The circulation deduced here for the region above 100 km is similar to the model of circulation suggested by Yerg (1951) from theoretical considerations. Moreover, the observations of winds above 100 km over the middle latitudes presented by Sheppard and Hoffmeister are in accord with the circulation in the thermosphere presented here. Though certain parts of this circulation, especially above 100 km and over very high and very low latitudes remain to be confirmed by observations of winds, the model of circulation in the upper atmosphere suggested here appears to be satisfactory.

From a consideration of the meridional gradients of zonal winds in the upper atmosphere, it is concluded that hydrodynamic instability is more likely to occur in the thermosphere than at lower levels. Such instability will break down the zonal flow and will destroy the zonal symmetry.

Microfilm \$2.00; Xerox \$3.00. 50 pages.

QUANTITATIVE DESCRIPTION OF SUCCESSIVE TRANSFORMATIONS IN ATMOSPHERIC SAMPLES

(L. C. Card No. Mic 59-2327)

Ernest Constantine Tsivoglou, Ph.D.
The Ohio State University, 1953

The dissertation is concerned with the problem of determining certain properties and aspects of the behavior of atmospheric mixtures of the radioactive gases and their daughter products. Evidence is presented to demonstrate that full radioactive equilibrium of the daughters with the parent gas seldom occurs in nature. Special attention is given to the case involving radon and its daughters, since

this case is of practical importance to the uranium mining industry, but the theory and methods apply equally well in the case of thoron, for example.

In connection with this mentioned goal, the dissertation is concerned with three specific problems. First, it was necessary to devise a satisfactory means of measuring the atmospheric concentrations of the daughters. Having perfected this method of analysis, the second phase of the work involves actual measurement of the atmospheric concentrations as they occur under conditions of natural and artificial ventilation, and finally, theory is presented for the quantitative estimation of the beneficial effects of ventilation in terms of reductions to be expected in the atmospheric concentrations of the gas and its daughters.

Quantitative Description of Successive Transformations

Since the present studies involve several modifications of the phenomenon of radioactive chain decay, a rather general treatment of this phenomenon is presented.

In brief, we let P_i be the constant rate of production of the i^{th} member of the chain, λ_i its decay constant and $N_i(t)$ the number of atoms of the i^{th} member present at time t . N_i^0 is the initial number of atoms, and f_i is a proportionality factor which relates the rate of removal by external means (such as ventilation) to $N_i(t)$. To simplify the resulting differential equations and solutions, we combine the phenomena of radioactive decay and removal by external means according to the relation:

$$c_i = \lambda_i + f_i,$$

and we desire a general solution to the following system of differential equations:

$$\frac{dN_i(t)}{dt} = P_i + \lambda_{i-1}N_{i-1}(t) - c_iN_i(t) \quad (1)$$

Systematic solution of the system (1) and proper rearrangement of terms leads to the following general solution:

$$N_i(t) = a_{0i} + \sum_{k=1}^i a_{ki} e^{-c_k t}, \quad (2)$$

$$\text{in which } a_{0i} = \frac{P_i}{c_i} + \frac{\lambda_{i-1}}{c_i} a_{0,i-1} \quad (2a)$$

$$\begin{aligned} \text{and } a_{ki} = & \frac{\lambda_k \lambda_{k+1} \dots \lambda_{i-1}}{(\lambda_i - \lambda_k)(\lambda_{i-1} - \lambda_k) \dots (\lambda_{k+1} - \lambda_k)} \left[(N_k^0 - \frac{P_k}{c_k}) \right. \\ & - \frac{\lambda_{k-1}}{(\lambda_k - \lambda_{k-1})} (N_{k-1}^0 - \frac{P_{k-1}}{c_k}) \\ & + \frac{\lambda_{k-2} \lambda_{k-1}}{(\lambda_k - \lambda_{k-1})(\lambda_{k-1} - \lambda_{k-2})} (N_{k-2}^0 - \frac{P_{k-2}}{c_k}) - \dots \\ & - \frac{\lambda_2 \lambda_3 \dots \lambda_{k-1}}{(\lambda_k - \lambda_{k-1})(\lambda_{k-1} - \lambda_{k-2}) \dots (\lambda_k - \lambda_2)} (N_2^0 - \frac{P_2}{c_k}) \\ & \left. + \frac{\lambda_1 \lambda_2 \dots \lambda_{k-1}}{(\lambda_k - \lambda_{k-1})(\lambda_{k-1} - \lambda_{k-2}) \dots (\lambda_k - \lambda_1)} (N_1^0 - \frac{P_1}{c_k}) \right]. \quad (2b) \end{aligned}$$

In equation (2a) we have that a_{0i} is simply $\frac{P_i}{c_i}$, and in equation (2b) the coefficient of the large bracket is unity for $k=i$.

The foregoing results are a general solution to the case in which there is production at constant rates of the various members of the chain and removal of the members at rates proportional to the existing numbers of atoms. In subsequent work, all specific equations needed are written down directly by the use of equations (2), (2a), and (2b); these general equations also include a number of other more limited cases such as those discussed in the text by Rutherford, Chadwick and Ellis.¹

Mathematical Analysis of Alpha Decay Curves

The method of determining atmospheric concentrations of the daughters of radon consists of mathematical analysis of the observed alpha decay curve from a filter paper sample of the atmosphere. Such decay curves are quite different in shape during the first 45 minutes of decay, depending upon the relative atmospheric concentrations of the daughters. The gaseous radon is not collected on filter papers; therefore, its concentration is not determined by this method. However, the hazard due to inhalation of radon is negligible compared to that connected with inhalation of the daughters,² hence, the analysis yields the desired information.

Two modified forms of the equation for successive transformations are needed for our present purposes. They are the particular expressions for the buildup of activity of the filter paper during sampling and for the decay of this activity after the completion of sampling. The first expression for the buildup during sampling is derived from equations (2), (2a), and (2b) by setting the N_i^0 and the f_i equal to zero and by letting P_i be replaced by $Q_i v$, where Q_i is the constant atmospheric concentration of the i^{th} member and v is the rate at which the atmosphere is sampled in liters per minute. This modified form then yields the specific expressions for the buildup on filter paper of each of the daughters during sampling, and hence yields the initial numbers for decay at the completion of sampling over any specified period of time.

The specific expressions for decay after the completion of sampling are obtained from equations (2), (2a), and (2b) by setting the P_i and the f_i equal to zero. The N_i^0 are determined or fixed by the previous expressions for buildup of activity during sampling, and the equations for decay yield the numbers of daughter atoms which are present at any time T after the completion of sampling. A general equation for the total alpha activity of any sample is then written down — in the present case, it is just the activity of RaA and RaC'. For this case involving radon and its daughters, the equation of total alpha activity involves three unknowns, which are the initial numbers of RaA, RaB and RaC. Three activities are therefore taken from the observed alpha decay curve and used in the equation of total alpha activity to permit the setting up of three equations in three unknowns. These equations are solved for the N_i^0 , and these initial numbers are then used in the expressions for buildup during sampling in order to obtain the atmospheric concentrations of RaA, RaB and RaC which existed during sampling. Finally, having determined the atmospheric concentrations by the foregoing means, it is a simple matter to express these concentrations as decimal fractions of the possible equilibrium concentrations, considering RaA as the parent element.

The results of the studies indicate that it is quite unusual to observe the full equilibrium condition — in no

case in the laboratory was equilibrium of all of the daughters observed. The studies later made in a uranium mine in southern Utah bear out this conclusion that full radioactive equilibrium of the daughters with radon seldom occurs in nature, and, in fact, can occur only under certain ideal conditions.

The accuracy of the foregoing method of analysis for the atmospheric concentrations of the daughters of radon has been studied and found to be quite satisfactory.

Pulse Amplitude Studies

As an independent check on the foregoing method of analysis of atmospheric samples, and as a means of making a thorough study of the characteristics of such samples, an experiment which permits the observation of the individual alpha activities of RaA and RaC' has been performed. The alpha particles from RaA and RaC' possess different energies (6.0 and 7.7 m.e.v. respectively), and this energy difference served as the basis for the separate measurement of the activities from a single atmospheric sample.

Atmospheric samples of the daughters of radon were collected on one-inch diameter copper planchets by the use of an electrostatic precipitator, in order to obtain a quite thin sample. The alpha particles emitted by the sample created pulses in a thallium-activated sodium iodide crystal, and these pulses were then amplified by use of an RCA 5819 photomultiplier tube. The amplified pulses were then sent into a DuMont type 303AH oscillograph, controls of which were set for driven sweep and were arranged to produce deflections in the Y-direction only. These amplitudes were then photographed from the screen of the oscillograph by means of a Fairchild Oscillo-Record camera. The climate of Utah, where these experiments were performed, is sufficiently dry so that no serious difficulty was experienced with the use of the NaI crystal phosphor. The exposed film was developed, and the amplitudes of each of the pulses were measured and recorded. It was found possible to detect the difference in pulse amplitude which arises because of the difference in particle energies, and as a result it was possible to measure separately the alpha activities of RaA and RaC' from a single atmospheric sample of the daughters of radon.

The experiment performed has two major advantages over other feasible equipment. In the first place, it is especially well-suited to the study of samples which have a relatively short-lived component such as RaA, and secondly, it permits the observation of all events which take place rather than only some fraction of the total number of events.

The total number of events which can be recorded by the foregoing technique depends on several factors, the major ones being the activity of the sample, the degree of collimation used, the permissible duration of film runs, and the requirement of adequate film exposure. A balance of these factors permitted the recording of over 1,000 events in a period of one minute, but simple modification of the experimental equipment to permit the recording of a considerably larger number of events over the same period of time has been outlined.

The major factors which affect the degree of resolution between the RaA and RaC' amplitude distributions are the condition of the NaI crystal, the thickness of the sample,

and the degree of collimation. Good resolution between the two distributions was obtained in all cases by achieving a proper balance of these factors.

Various tests were applied to the data obtained from the study of pulse amplitudes, and these tests demonstrated that the constituents and properties of atmospheric samples of the daughters of radon were as expected.

In order to test the method of calculating equilibrium ratios for the daughters, simultaneous atmospheric samples were collected in the electrostatic precipitator. One was analyzed on the basis of pulse amplitude distributions, and the other on the basis of its observed alpha decay curve. It is pointed out that the results of the analysis based on an observed decay curve are more accurate, mainly because the study of pulse amplitudes involves the observation of a smaller number of events over any one period. Still, quite good agreement was found between the equilibrium ratios determined by the two independent methods of analysis, and the deviations between individual ratios were observed to be of a random nature.

Studies in Uranium Mines and Ventilation Theory

Consider the case of a radioactive gas which is produced at a steady rate, P_1 , and liberated into a restricted volume, V , which is ventilated by mechanical means at a rate q cubic feet per minute. For practical purposes this is the situation in a drift of a uranium mine which is being ventilated. In equations (2), (2a), and (2b) therefore, except for P_1 , the P_i are all zero; the N_i^0 are not zero; and f_i is simply $\frac{q}{V}$. These conditions permit us to write

down directly the specific expressions which predict the effects of ventilation of such a restricted volume concerning the reductions to be expected in the atmospheric concentrations of radon and each of its daughters. These expressions have been presented and applied in a study of the effects of ventilation in a uranium mine in southern Utah.

Study of the limiting cases of the foregoing expressions demonstrates clearly that full radioactive equilibrium of the daughters with the parent gas cannot be expected to occur unless there is complete absence of either natural or artificial ventilation, and this conclusion is supported by the studies in the uranium mine. The equation for radon permits a calculation of the actual rate of emanation or production of the gas, and it is suggested that this may be of some use in the field of exploration and development of sources of uranium. Simple modification of the equation for radon results in a quantitative description of the effects of ventilation, regarding atmospheric concentrations of a nonradioactive gas.

In no case during the studies in the uranium mines was full radioactive equilibrium of the daughters with the parent gas observed, although this condition was approached under undisturbed natural mine conditions. It has been shown that there is quite good agreement between the observed atmospheric concentrations of the gas and its daughters and the concentrations predicted by the theoretical equations which describe the effects of ventilation. Certain discrepancies between the observed and predicted results for RaB and RaC were observed, and a logical explanation of their occurrence has been presented.

In general, ventilation of uranium mines is a very effective means of controlling atmospheric concentrations of radon and its daughters. Ventilation causes wide de-

partures from the equilibrium condition, as well as causing sharp reductions in the actual concentrations of the gas and its daughters, and, in general, the higher the rate of fresh air introduction, the greater are these departures from the equilibrium condition. The effects of natural ventilation have been estimated, and it is also demonstrated that natural ventilation plays an important, while not sufficiently great, role in maintaining the atmospheric concentrations of the parent gas and its daughters at levels considerably below the levels that they might attain.

Summary and Conclusions

A satisfactory method of analysis for the determination of actual atmospheric concentrations of the daughters of radon has been presented, and has been tested and verified by an independent experimental technique in the laboratory. Studies of atmospheric mixtures of radon and its daughters in the laboratory and in uranium mines have demonstrated that the occurrence in nature of full radioactive equilibrium between the atmospheric daughters and the parent gas is quite unusual; actual atmospheric concentrations of the gas and its daughters as they occur have been measured and presented.

Theoretical expressions which predict the quantitative effects of ventilation of a restricted volume such as a uranium mine drift have been supported by observations in a uranium mine. These expressions predict that as a usual thing atmospheric mixtures of radon and its daughters will reflect a nonequilibrium condition. Ventilation of uranium mines is very effective as a means of protecting the health of workers in this industry, causing adequate reductions in the atmospheric concentrations of the parent gas and its daughters as well as marked departures from the equilibrium condition. It has been suggested that since the health hazard caused by the inhalation of radon is insignificant compared to that associated with inhalation of the daughters, the standard for the protection of the health of workers in the uranium mining industry should be based upon observed daughter activities rather than on observed radon concentrations.

Microfilm \$2.00; Xerox \$5.80. 116 pages.

1. Rutherford, E., Chadwick, J. and Ellis, C. D. Radiation from Radioactive Substances. New York: Cambridge University Press, 1930, pp. 1-37.

2. Morgan, K. Z. "Maximum Permissible Concentration of Radon in the Air." Unpublished paper, October, 1951.

Abstract published by special arrangement with The Ohio State University.

PHYSICS, NUCLEAR

SOME CALCULATIONS FOR THE
NUCLEI Li^6 AND N^{14}

(L. C. Card No. Mic 59-1870)

Donald Ray Childs, Ph.D.
Vanderbilt University, 1959

Supervisor: Dr. Ingram Bloch

Within the framework of first order perturbation theory some calculations are made for the two nuclei Li^6 and N^{14} . The perturbing potential used is of the form

$$H = \sum_{i < j} \left[A e^{-r_{ij}^2/k^2} + B P_{ij} e^{-r_{ij}^2/k^2} + C S_{ij} e^{-r_{ij}^2/k^2} + D P_{ij} S_{ij} e^{-r_{ij}^2/k^2} + E (\vec{r}_{ij} \times \vec{p}_{ij}) \cdot \frac{(\vec{s}_i + \vec{s}_j)}{\hbar^2} e^{-r_{ij}^2/k^2} + F P_{ij} (\vec{r}_{ij} \times \vec{p}_{ij}) \cdot \frac{(\vec{s}_i + \vec{s}_j)}{\hbar^2} e^{-r_{ij}^2/k^2} \right] - \frac{1}{2} b \sum_i r_i^2,$$

where P_{ij} is the Majorana operator, and A, B, C, D, E, F, k , and b are constants. The first two terms represent a Gaussian central force interaction. Terms 3 and 4 represent the tensor interaction, where

$$S_{ij} = \frac{3(\vec{\sigma}_i \cdot \vec{r}_{ij})(\vec{\sigma}_j \cdot \vec{r}_{ij})}{r_{ij}^2} - (\vec{\sigma}_i \cdot \vec{\sigma}_j).$$

Terms 5 and 6 represent an interaction due to a spin orbit type of force, and the last term is the unperturbed well which has been subtracted out to make the total Hamiltonian bounded everywhere. The tensor force is included since it is able to account for the data of a simple system; i.e., the deuteron. The $\vec{L} \cdot \vec{S}$ force is added to distinguish between the two nuclei Li^6 and N^{14} , and also because there is some evidence of velocity dependent forces.

The unperturbed eigenfunctions are solutions of the equation

$$H\psi = E\psi$$

and are written as two antisymmetrized products of single particle proton and neutron wave functions in the form of a Slater determinant. The single particle eigenstates are written in the form of $U_k(\vec{r}_i)\alpha_k$ or $U_k(\vec{r}_i)\beta_k$, where the U_k are eigenfunctions of the operator

$$-\frac{\hbar^2}{2m} \sum_i \nabla_i^2 + \frac{1}{2} b \sum_i r_i^2$$

with eigenvalue $E_k = \sum (n_{kx} + n_{ky} + n_{kz} + \frac{3}{2}) \hbar \sqrt{\frac{b}{m}}$,

and the α_k or β_k are the spin eigenstates of the operator

$$\sigma_z = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}. \text{ The } U_k \text{ are expressed in such a manner as}$$

to represent single particle states of definite l and l_z and

are of the form $r^k e^{ik\phi} e^{-\alpha^2 r^2}$, where $\alpha^2 = \frac{mb}{\hbar^2}$, and $\phi =$

$\tan^{-1} \frac{y}{x}$. The matrix elements are then calculated for this representation.

The parameters are chosen as follows:

$$A = -29.5 \text{ mev.}$$

$$B = 0$$

$$C = D = -\frac{1}{2}(17.4) \text{ mev.}$$

$$E = F = -\frac{1}{2}(4.5) \text{ mev.}$$

$$k = 1.29 \frac{e^2}{mc^2}$$

$$\alpha = 1.1 \sqrt{2} \frac{mc^2}{e^2}$$

$$\frac{e^2}{mc^2} = 2.82 \times 10^{-13} \text{ cm.}$$

The parameters are chosen to account for the magnetic and quadrupole moments of the deuteron, the singlet-triplet splitting of the deuteron, and for neutron-proton scattering data.

A new representation is chosen to give as many diagonal matrix elements as possible. The new base vectors are simultaneously eigenfunctions of the operators J^2 , L^2 , and S^2 and are constructed from the old base vectors by means of a unitary transformation $\phi = S\psi$. The columns of the unitary operator S are the old base vectors ψ and the rows are the new base vectors ϕ_{JM} . The matrix elements are now written in the form

$$(\phi_{JM}^i, H \phi_{JM}^k).$$

Using the above parameters in the new representation an energy level diagram is obtained for each of the two nuclei. All levels represent states of even parity since they were constructed from the unperturbed ground state. In addition the magnetic moments of these two nuclei are calculated using zero-order wave functions. The values obtained are 0.784 n.m. for Li^6 and 0.340 n.m. for N^{14} . The experimental values are 0.826 n.m. for Li^6 and 0.404 n.m. for N^{14} . The first order wave functions are constructed and it is found that second order effects can be neglected. Microfilm \$2.00; Xerox \$4.20. 78 pages.

SCATTERING OF 19-MEV ALPHA PARTICLES
BY C^{12} , O^{16} , AND S^{32}

(L. C. Card No. Mic 59-1612)

John Charles Corelli, Ph.D.
Purdue University, 1959

Major Professor: E. Bleuler

The elastic and inelastic scattering of 19-Mev alpha particles from gaseous targets of propane (C_3H_8), oxygen (O_2) and hydrogen sulfide (H_2S) and by a thin foil of polyethylene (CH_2) has been measured. The targets were bombarded by the external and focussed 19-Mev alpha-particle beam of the Purdue University cyclotron. Scattered alpha particles were detected by means of 63 nuclear plates (Ilford E-1 emulsions, 100 μ thick) spaced every

2.5° in a multiplate scattering chamber covering the range of angles from 10° to 170° (laboratory).

The elastic angular distribution from each nucleus exhibits a diffraction-like pattern typical of light and medium-heavy elements. The elastic scattering cross sections for carbon and oxygen deviate strongly from pure Coulomb scattering and sharply rise above the Rutherford cross sections in the backward angles. At 172.5° The ratio of the measured elastic to Rutherford cross section is 690 for carbon and 375 for oxygen. Diffraction radii are calculated using the crude black sphere diffraction scattering model. The values of diffraction radii obtained in this way are C^{12} ; $R = 7.9 \times 10^{-13}$ cm, O^{16} ; $R = 4.34 \times 10^{-13}$ cm and S^{32} ; $R = 6.70 \times 10^{-13}$ cm.

The angular distribution for the 4.43-Mev (2^+) level of carbon was measured from 15° to 121° (CM). A good fit to the data from the 4.43-Mev level is obtained using a

$[j_2(QR)]^2$ dependence as predicted by the first-order

direct-interaction theory. This yields the value 5.5×10^{-13} cm for the interaction radius. Partial angular distributions are measured from the 7.65-Mev (O^+) and 9.61-Mev (?) levels of carbon. The scattering from the 9.61-Mev state exhibits a smooth monotonic decrease in cross section with forward peaking and no pronounced structure in the region of angles measured (20° to 78° CM). The scattering cross sections from the 7.65-Mev (O^+) level are an order of magnitude smaller than those observed from the 4.43 and 9.61-Mev levels.

The angular distributions of alpha particles inelastically scattered by oxygen from the unresolved doublets of the first and second excited states at 6.06, 6.14 Mev and from the 3rd and 4th excited states at 6.91, 7.12 Mev were measured from 11° to 120° (CM). These data are compared to the inelastic scattering data from the fifth excited state of oxygen at 8.87 Mev (2^-), which was measured from 13.9° to 105.6° (CM). The inelastic scattering cross sections from the 2.24-Mev (2^+) first excited state of sulphur were measured from 11.3° to 171.3° (CM). The angular distribution exhibits a forward peaking and a diffraction-type pattern. An estimate of the interaction radius from the distribution for this state using first-order direct-interaction theory yields the value 6.5×10^{-13} cm. A detailed calculation of the second-order geometry effect on the scattering cross sections is presented which can be specialized to any counting geometry.

Microfilm \$2.00; Xerox \$6.80. 145 pages.

ANGULAR CORRELATION MEASUREMENTS IN Ti^{203}

(L. C. Card No. Mic 59-2229)

Bernhard Irwin Deutch, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Norman Goldberg

Angular correlation measurements have been made on the 400 Kev and 279 Kev transitions following electron capture from 52 hour Pb^{203} . The following directional correlations were measured: gamma-gamma, K conversion electron - gamma, and gamma - K conversion elec-

tron. The angular distribution of all measurements were of the form $W(\theta) = 1 + A_2 P_2(\cos \theta)$. The following results were obtained. For the 400 γ - 279 Ke^- correlation $A_2 = -0.052 \pm 0.015$, for the 279 γ - 400 Ke^- correlation $A_2 = -0.036 \pm 0.010$ and for the 400 γ - 279 γ correlation, $A_2 = -0.151 \pm 0.010$. No effects due to perturbations of the intermediate state were found.

Using the well measured 279 Kev K conversion coefficient, the 400 Kev K conversion coefficient was determined to be 0.127 ± 0.020 while the 680 Kev K conversion coefficient was determined to be $0.009 \pm .005$. From these results and the mixture ratio in the 279 Kev transition determined by Stelson and McGowan, the mixture ratio in the 400 Kev transition was determined to be $\delta_{400} = +.043 \pm .010$. From this mixture and lifetime measurements, one can determine the 400 Kev M1 transition probability (ℓ allowed) which is .66 times the single particle prediction and similarly the 279 Kev M1 transition probability (ℓ forbidden) which is 1.5×10^{-3} times the single particle model prediction. The correlations involving conversion electrons rule out a $3/2 - 3/2 - 1/2$ transition. They indicate that the M1 particle parameter in the 400 Kev transition is about twice the theoretical prediction. The particle parameters for the 279 Kev transition also do not agree with the theoretical predictions. The significance of the disagreements is discussed.

Microfilm \$2.00; Xerox \$4.00. 73 pages.

CYCLOTRON BOMBARDMENTS WITH He^3 AND H^3

(L. C. Card No. Mic 59-2283)

Thomas William Donaven, Ph.D.
The Ohio State University, 1952

A few cubic centimeters of He^3 or H^3 gas sealed in a glass capsule was procured from the Oak Ridge National Laboratory. Arrangements were made to crush open the

Table I

Reaction	Half-life	Particle Energy in TWD.	Remarks
$Be^9(He^3,n)C^{11}$	20 minutes	21	
$C^{13}(He^3,He^4)C^{11}$	20.74 ± .10 minutes	21	Followed for 15 half-lives
$O^{16}(He^3,He^4)O^{15}$	2.06 minutes	13	
$O^{16}(He^3,p)F^{18}$	1.87 hours	21, 13	Found on many samples
$Al(He^3)$	none	21, 13	No activity found
$Si^{28}(He^3,p)^{30}$	2.64 minutes	13	
$Si^{30}(He^3,2p)Si^{31}$	2.8 hours	13	Doubtful
$Si^{30}(He^3,p)p^{32}$	14 days	13	
$Fe^3(He^3,-) --$	several days	21	.005 counts per second
$Co(He^3,-) --$	none	21	
$Ni^{58}(He^3,p)Cu^{60}$	24.6 minutes	13	
$Ni^{60}(He^3,d)Cu^{61}$	3.4 hours	13	
$Ni^{60}(He^3,n)Zn^{62}$	8.4 hours	13	
$Ni^{62}(He^3,p)Cu^{64}$	12.8 hours	13	
$Ni^{58}(He^3,d)Ni^{57}$	1.5 days	13	
$Ge^{76}(H^3,n)As^{76}$	1.46 hours	6.5	Ge^{76} used
$Ge^{76}(H^3,n)As^{77}$	1.67 days	6.5	Enriched to about 80%
$Ge^{74}(H^3,n)As^{76}$	1.12 days	6.5	
$Ge^{70}(H^3,d)Ge^{71}$	11.4 days	6.5	
$As(He^3,-) --$	none	21	
$Ag^{109}(H^3,He^3)Pd^{109}$	13 hours	6.5	
$Ag^{109}(H^3,p)Ag^{111}$	7.5 days	6.5	
$Ag^{109}(H^3,d)Ag^{110}$	270 days	6.5	Not certain
$Ag^{109}(H^3,n)Cd^{109}$	470 days	6.5	Not certain
$In(He^3,-) --$	none	21	
$Ta(He^3,-) --$	many days	21	Very weak activity
$Au(He^3,-) --$	none	21	
$Po(He^3,-) --$	none	13	
$Bi(He^3,-) --$	none	13	No alpha or beta particles

capsule inside the cyclotron vacuum system. A recirculation system for these gasses was worked out which is as follows. The main oil diffusion pump was backed by the two mercury diffusion pumps in parallel, the gas from the exhaust outlet of the mercury pumps went into a big ballast tank and was then led into a liquid air trap and later through a set of circulation control valves into a liquid hydrogen trap. The He^3 or H^3 was then put back into the cyclotron tank.

The energy of the He^3 particles was 21 m.e.v. or 13 m.e.v. and the energy of the H^3 particles was 6.5 m.e.v.; all energies were calculated from the frequencies of the cyclotron oscillator. The initial resonances were detected by the neutrons and gamma rays from a Be target.

Table I summarizes the activities produced. The activities were identified mainly by their half-lives and in some cases by their characteristic decay products.

Microfilm \$2.00; Xerox \$3.00. 43 pages.

Abstract published by special arrangement with The Ohio State University.

NUCLEAR CHARGE DISTRIBUTION CURVES IN FISSION: INDEPENDENT YIELDS OF ^{91}Sr , ^{139}Ba , AND ^{140}Ba FROM THERMAL-NEUTRON FISSION OF ^{235}U

(L. C. Card No. Mic 59-1742)

Robert Lynn Ferguson, Ph.D.
Washington University, 1959

Chairman: Professor Arthur C. Wahl

Precipitation of strontium and barium as nitrates from cold, fuming nitric acid was found to separate strontium from rubidium and barium from cesium very cleanly. In experiments based on this separation method strontium and barium activities were removed very quickly (< 1 min) following a short irradiation of U^{235} with thermal neutrons. For the nuclides given below this separation occurred before the portion of the strontium or barium activity due to independent formation was overshadowed by that due to decay of the relatively short-lived rubidium or cesium precursor, and the following independent yields (expressed as fractions of total chain yields) were determined: Sr^{91} , 0.06 ± 0.04 ; Ba^{139} , 0.011 ± 0.005 ; Ba^{140} , 0.07 ± 0.03 .

These results, considered in conjunction with other recently measured yields (cumulative yields of Kr^{91} , Xe^{139} , and Xe^{140} and the independent yield of La^{140}) afford knowledge of the nuclear charge distribution over four members of the mass-140 chain and over three members of the mass-91 chain and of the mass-139 chain. Thus, for the first time, charge distribution curves are obtained which are based entirely on the measured yields for several members along specific mass chains.

That the yields of all three mass chains can be fitted with a single curve (the charge distribution curve normally used in conjunction with the postulate of equal charge displacement gives good agreement with the data) supports the assumption that one, symmetrical charge distribution curve is applicable to most fission-product chains.

The independent yields of the 83-neutron nuclides Ba^{139}

and La^{140} do not appear to be abnormally low. This is not in accord with the proposal that excessive neutron boil-off occurs from fission fragments with one neutron in excess of the 82-neutron closed shell configuration.

New values were obtained for the following half-lives: Rb^{91} , 68 ± 10 sec; Rb^{92} , < 12 sec; Cs^{141} , 25 ± 10 sec; Cs^{142} , < 17 sec. An upper limit of 5×10^{-4} was set for the fraction of the 91 chain decaying to 9.67-hr Sr^{91} through the previously reported 14-min Rb^{91} isomer.

BIOGRAPHICAL DATA

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Place of Birth: Mayfield, Kentucky
Undergraduate Study: Murray State College, 1950-1954.
Graduate Study: Washington University, 1954-1959.
Scholastic and Professional Experience: Summer Employee, Mallinckrodt Chemical Works, 1954, 1955; Teaching Assistant, Washington University, 1954-1955, 1955-1956; Summer Student, E. I. du Pont de Nemours and Company, 1956; DuPont Fellow, Washington University, 1956-1957; Research Assistant, Washington University, 1957-1959.
Membership in Scholastic and Professional Societies: Sigma Xi; American Chemical Society.
Honors: Donall H. Sylvester Scholarship, 1954; DuPont Fellowship, 1956-1957.
Microfilm \$2.00; Xerox \$3.00. 57 pages.

NON-LINEARITY OF THE FERMI PLOT OF THE BETA DECAY OF OXYGEN - FOURTEEN

(L. C. Card No. Mic 59-1904)

David Tobias Goldman, Ph.D.
University of Maryland, 1958

Supervisor: Dr. Richard A. Ferrell

The anomalously long half-life for the Gamow-Teller allowed transitions of O^{14} and C^{14} to the ground state of N^{14} can be satisfactorily explained by an accidental cancellation in the allowed beta decay nuclear matrix element. Thus, the forbidden terms in the expansion of the matrix element of the interaction Hamiltonian make a non-negligible contribution to the total matrix element. Specifically, the $ft_{1/2}$ value and the Fermi plot are modified by the forbidden terms. In the present dissertation the general theory of beta decay is systematically developed for the most general form of a local interaction Hamiltonian. The beta decay of N^{16} is then considered as an example of the familiar type of forbidden transition. We then consider the beta radioactivity of the fourteen nucleon isotopic spin triplets, including the contributions

of the forbidden terms to the total matrix element. It is shown that the higher energy available in the O^{14} decay makes the effect of the forbidden terms much more manifest than in the C^{14} decay. Since the effect depends on the type of interaction actually responsible for the beta decay, it is pointed out that an experimental measurement of the degree of non-linearity in the O^{14} Fermi-Kurie plot would give information on the form of the interaction, as well as the invariance of the interaction with respect to time inversion. The non-linearity to be expected on the basis of the presently accepted type of interaction is computed in detail. It is found that at an electron energy equal to three fourths of the total decay energy, the deviation of the Fermi-Kurie plot from linearity should be 6.2%. The non-linearity is proportional to the forbidden nuclear matrix element $|\bar{\alpha} \times \vec{r}|$, whose value has been computed on the basis of shell-model wave functions. The half-life of the first excited state of N^{14} is inversely proportional to the square of this same matrix element, and using shell-model wave functions is computed to be $t_{1/2} = 2.0 \times 10^{-14}$ sec. Experimental determination of the lifetime of this state would furnish an independent means for evaluating the forbidden term which is responsible for non-linearity.

Microfilm \$2.00; Xerox \$6.60. 137 pages.

THE MECHANISM OF THE DIRECT INTERACTION PROCESS OF NUCLEAR REACTIONS AT INTERMEDIATE ENERGIES

(L. C. Card No. Mic 59-2353)

Richard John Griffiths, Ph.D.
University of Minnesota, 1959

At intermediate energies there is reason to believe that a large percentage of inelastic proton scattering events go by a direct mechanism. Several mechanisms for direct interactions have been suggested in the past decade. These include: (a) nucleon nucleon collisions in the diffuse rim, (b) a knock-on process occurring over the whole nucleus, (c) direct excitation of low lying rotational states; and many others. To distinguish between these processes, it has been suggested that the measurement of the angular correlation of pairs of protons emitted in time coincidence would be a powerful method.

The predominant mechanism for the inelastic scattering of 40 mev protons on a thin nickel foil (heated to remove contaminants) has been determined by this method. The angular correlation in the range of separation angles 50° to 105° has been obtained together with the energies of each of the emitted protons. Large solid angle plastic scintillator detectors, and coincidence resolving times of ten millimicroseconds were used and two-dimensional energy spectra plotted from the data collected photographically. Copper, nickel, lead, and tantalum were used as targets and the data have been interpreted in terms of a model.

The shape and magnitude of the angular correlation proves that "nucleon nucleon collisions" is the predominant direct interaction mechanism at this energy. With the aid of a semi-classical model involving nucleon nucleon collisions, the correlation curves and the two-dimensional energy spectra have been fitted by using a zero tempera-

ture Fermi distribution of the struck nucleons (with $P_F^2 = .5$ to 1.0 mev inequivalent proton energy units) and a distribution of the recoil momenta "q" of the residual nuclei peaked at $q^2 = 2$ mev.

This model strongly suggests that the process takes place in the diffuse rim and proves that the interaction involves primarily low momentum transfers. The effect of the core of the nucleus interfering with the emission of proton pairs is discussed, and the results are consistent with the direct interaction mechanism being at this energy, primarily "two body collisions in the diffuse rim, involving low momentum transfers".

This being the case, the independent particle model appears to be incapable of interpreting the results of this experiment which investigates the reactions and momenta occurring in a definite part of the nucleus.

Microfilm \$2.00; Xerox \$4.00. 72 pages.

THE $B^{11}(\alpha, n) N^{14}$ REACTION

(L. C. Card No. Mic 59-1752)

Eugene Haddad, Ph.D.
University of Utah, 1959

Chairman: Dr. Thomas J. Parmley

He^+ ions from the large Los Alamos electrostatic accelerator were used to bombard thin B^{11} targets and the resulting neutron spectra were measured by a time-of-flight method. The absolute zero-degree differential cross section was obtained for the $B^{11}(\alpha, n_0)N^{14}$ reaction for the alpha-particle energy range from 1.9 to 6.9 Mev, the $B^{11}(\alpha, n_1)N^{14}$ reaction from 3.5 to 6.9 Mev, and the $B^{11}(\alpha, n_2)N^{14}$ reaction from 5.3 to 6.9 Mev. Resonances were found in the zero degree cross section curves at excitation energies in N^{15} corresponding to 12.51, 12.90, 13.14, 13.17, 13.36, 13.60, 13.71, 13.85, 14.08, 14.16, 14.63, 14.90, 15.01, 15.08, 15.29, 15.37, 15.61, 15.92, 15.93, 15.99, and 16.04 Mev.

Angular distributions were obtained for the neutrons associated with the ground state transition for the alpha-particle energy range from 1.92 to 5.72 Mev and for the first excited state from 3.73 to 4.74 Mev. From the angular distributions, values for the total reaction cross section were obtained for the $B^{11}(\alpha, n_0)N^{14}$ reaction for the energy region from 1.92 to 5.72 Mev.

The angular distributions for alpha-particle energies above 2.05 Mev were found to exhibit asymmetry about 90° in the center-of-mass system while the angular distribution at 2.05 Mev was symmetric about 90° . A theoretical analysis of the 12.50-Mev state in N^{15} led to a spin and parity assignment of $\frac{5}{2}^+$. Qualitative arguments are used to show that the 12.90-Mev state in N^{15} is not a pure state.

Microfilm \$2.00; Xerox \$6.40. 133 pages.

* Work performed under the auspices of the U.S. Atomic Energy Commission.

THE SPIN AND HYPERFINE SPLITTING OF Au^{194}

(L. C. Card No. Mic 59-1553)

William McClure Hooke, Ph.D.
Princeton University, 1958

The atomic beam magnetic resonance technique has been used to measure the spin and hyperfine splitting of Au^{194} . The Au^{194} was chemically separated from platinum targets bombarded at Brookhaven and Princeton. From the analysis of $\Delta F = 0, |\Delta M_f| = 1$ transitions observed at six different C-magnetic field intensities we obtain $I = 1\frac{1}{2}$ and $\Delta\nu_{\text{Au}^{194}} = 3600 \pm 120$ mc/sec. The absolute value of the Au^{194} magnetic moment is $.07 \pm .01$ nm. The spins and moments of Au^{194} and several other gold isotopes have been analysed from the point of view of the shell and collective nuclear models. Collective model magnetic moment relations have been derived for odd-odd nuclei, so that one may use S. G. Nilsson's calculations for the wave functions of nucleons in a spheroidal potential. In addition, a report is given on progress in obtaining an atomic beam of eighteen-second Neon¹⁹.

Microfilm \$2.00; Xerox \$7.00. 147 pages.

ALPHA DECAY AMPLITUDES AND THEIR PHASES

(L. C. Card No. Mic 59-2204)

Leston Wayne Miller, Ph.D.
University of Washington, 1959

Chairman: Boris Jacobsohn

A method is given for explicitly separating the resonant from the non-resonant effects in the alpha decay of non-spherical nuclei. The non-resonant effects correspond physically to Coulomb excitation (or de-excitation) of the nucleus by the alpha particle when it is outside of the barrier; although this part of the coupling is weak, the small $l = 4$ amplitude is much altered by its coupling to the strongly populated $l = 2$ channel. This effect provides all of the phase (beyond the usual Coulomb monopole phase) of the amplitudes. Semi-empirical curves of the $l = 4$ amplitudes as a function of mass number for even A alpha emitters are presented; the imaginary part remains almost constant while the real part varies strongly, going through zero near $A = 244$.

A matrix is defined which provides the connection between the real parts of the amplitudes at infinity and the alpha particle wave function near the nuclear surface. The dependence of this matrix on the angular momentum of the alpha emitter is investigated semi-quantitatively; it is shown that, for the electrostatic coupling strengths which occur in nature, this angular momentum dependence is negligible.

A Born approximation method is used to calculate (qualitatively correct) alpha particle wave functions near the nuclear surface from the real parts of the alpha decay amplitudes for even-even nuclei. The calculation is carried out for sixteen even-even alpha emitters in the transuranic region. Plots of the alpha particle partial waves near the nuclear surface as a smooth function of mass number are presented.

It is assumed that this smooth variation with mass number extends also to odd mass alpha emitters and certain experimental consequences of this assumption are examined and discussed. In particular, a discussion of the information which may be obtained from alpha particle angular distribution and angular correlation experiments is given. A general formula for a quantity which enters into the calculation of the possible results of such measurements is presented. The results of the existing experiments of this type are discussed briefly. The possibility of measuring the sign of the real part of the small $l = 4$ amplitudes is examined. It is concluded that this measurement might be possible for nuclei of mass number near 230 or 250. The results of the measurement of an alpha-gamma angular correlation with polarized initial Am^{241} nuclei are predicted. It is concluded that this measurement would be very difficult to perform and that it would not yield any valuable information about the relative phase of the $l = 4$ amplitude.

In an appendix there is a brief investigation of the effect of nuclear rotation on the alpha particle wave function near the nuclear surface for a model in which the alpha exists in the nucleus for a time which is infinitely long compared to the nuclear rotation period. The model considered consists of an alpha bound by a non-spherically-symmetric harmonic oscillator potential. It is shown that the rotation of the nucleus will not result in a significant difference in the nuclear surface alpha particle wave functions for even-even and odd nuclei.

Microfilm \$2.00; Xerox \$5.40. 104 pages.

THE DETERMINATION OF
PHOTONEUTRON THRESHOLDS

(L. C. Card No. Mic 59-2422)

William Shelton Rawls, Ph.D.
Iowa State College, 1959

Supervisor: L. Jackson Laslett

The photoneutron thresholds of twelve nuclides were measured, using the Iowa State College synchrotron and its associated energy control device.

The delayed neutron detection method was used, in which four proportional neutron counters were embedded in a paraffin neutron house; a delayed electronic gate permitted neutrons to be detected during a 600 microsecond interval beginning 50 microseconds after beam extraction. Two methods were used to monitor the synchrotron beam intensity: 1) by a transmission ionization chamber placed in the path of the synchrotron beam, and 2) the Newkirk method in which the photoneutron yield from the sample during alternate cycles of the machine, at some fixed reference energy setting, acted as the monitor.

A calibration curve for the energy control device (integrator) to convert integrator settings into electron momenta was obtained, using measured thresholds of deuterium, lithium 7, lanthanum, praseodymium, copper 65, manganese, copper 63, and aluminum, together with their respective last neutron binding energies as calculated from precision mass data. A modified calibration

curve was drawn, for which the integrator setting and associated electron momentum at injection time provided an additional calibration point. This modified calibration curve was judged to be more reliable than the first curve because the injector voltage could be determined with good absolute accuracy and the location of the corresponding point was particularly favorable to improve the accuracy on the lower portion of the calibration curve.

The measured thresholds of vanadium, yttrium, and phosphorus were studied, and spin and parity selection rules employed in an attempt to identify the breaks as due to ground state transitions or as due to transitions to excited nuclear levels. In some cases it is apparent that a true threshold might be overlooked experimentally when the corresponding transitions are suppressed, and an apparent threshold result from transitions to an excited state.

The threshold of bismuth was measured, using the abovementioned calibration curves, and a threshold value of 7.40 ± 0.05 Mev (standard error) was assigned to this element. Microfilm \$2.00; Xerox \$5.00. 96 pages.

INTERACTION CONTRIBUTION TO NUCLEAR ISOMERISM

(L. C. Card No. Mic 59-950)

Aubrey Rotenberg, Ph.D.
New York University, 1956

Adviser: Professor L. Spruch

There are some magnetic multipole isomeric transitions which would seem to be forbidden on a Mayer model of the nucleus, in that the ordinary magnetic moment operator is incapable of accounting for them. There are then two possible explanations for these transitions; either the nuclear model or the magnetic moment operator can be modified. The former corresponds to the admission of admixtures to the nuclear wave functions and has been considered by other authors who get fair agreement with the data at the expense of what seems to be an unreasonably large departure from the Mayer model.

Modifications of the magnetic moment operator involve the consideration of the currents due to exchange of mesons between nucleons. These currents give rise to what are known as interaction contributions to the magnetic moment operator and have had some success in accounting for the deviations of the magnetic moments from the values expected on the Mayer model -- the Schmidt lines. Applied to isomeric transitions, interaction effects will give contributions to all transitions, but if the possibility of admixtures to the wave functions is arbitrarily ruled out, then interaction effects are the only way to account for the forbidden isomeric transitions.

The most general interaction operator has been written down phenomenologically for the dipole case to within arbitrary functions of the internucleon distance. For the octupole, the only other multipole of interest, no attempt has been made to derive the most general operator but some of the terms have been written down by an extension of a method proposed by Villars and Weisskopf. It is shown that not all of the terms appearing in these inter-

action operators need be considered; some will give no contribution to the forbidden transitions due to certain selection rules; the contribution of others may be expected to be small under certain circumstances which are discussed.

If the strength of the operators is chosen to account for the H^3 - He^3 magnetic moment data, they seem unable to explain either the magnetic moment deviations of the heavy nuclei from the Schmidt lines or the forbidden isomeric transitions. In spite of this, interaction contributions may still be the explanation of these phenomena. Thus, for example, it may be that in passing from the very light to heavy nuclei the form of the interaction operator is changed. This could happen if in heavy nuclei, the interaction moment is due to both two body and many body operators which can be represented by an effective two body moment operator.

The transition probabilities are evaluated on both a shell and Fermi gas model of the nucleus. On both models the spin and angular integrations can be carried out exactly assuming the Mayer model assignments for these coordinates. The radial integrals are more complicated and can be done only if certain assumptions are made regarding the radial wave functions and the arbitrary functions appearing in the operator. It turns out that on the Fermi model the radial integral is the same for all dipole transitions and so need not be evaluated. The integral is set equal to that value which gives the best agreement with experiment. Unfortunately the Fermi model cannot give results for octupole transitions and so for these shell model results are used.

Thus, the interaction contribution to the isomeric transition probability has been studied where, in the interests of simplicity, only those terms in the interaction operator have been used which remain after what are probably unduly restrictive requirements have been placed on the operator. However, the results presented show that even with these restrictions interaction effects seem to be able to account for forbidden isomeric transitions.

Microfilm \$2.00; Xerox \$5.00. 99 pages.

EXCITATION STUDY OF $F^{19}(n,\alpha)N^{16}$

(L. C. Card No. Mic 59-2495)

Daniel Montague Smith, Ph.D.
The University of Texas, 1959

Supervisor: Dr. E. L. Hudspeth

The excitation function for the $F^{19}(n,\alpha)N^{16}$ reaction has been obtained by studying the postbombardment decay of N^{16} in a barium fluoride scintillator. For the purposes of this work, the scintillation properties of a 1-inch by 1/2-inch single crystal of barium fluoride were investigated with Na^{22} γ -rays, and definite photopeaks were observed. A direct comparison, using a Du Mont K1306 photomultiplier tube, gave a value of about 10 for the ratio of $NaI(Tl)$ to BaF_2 pulse height. The relative excitation curve was obtained by bombarding this crystal with d-d neutrons, using the "leaky integrator" technique,¹ and observing the N^{16} decay after cessation of bombardment. Monoenergetic neutrons were produced in a deuterium gas target by

bombardment with deuterons accelerated in the 4.0 Mv electrostatic generator at The University of Texas. Unwanted counts due to delayed activity from the competing reaction $F^{19}(n,p)O^{19}$ and from contaminant reactions in the deuterium target were rejected by pulse height discrimination. Resonances were observed at neutron energies of 4.084, 4.360, 4.520, 4.790, 4.900, 5.150, 5.400, and 5.9 Mev, confirming the results of Bostrom, Hudspeth and Morgan,² and of Marion and Brugger.³ The absolute cross section was obtained at 4.48 Mev by making a decay curve analysis of data taken with the counting equipment biased at zero, and estimating the neutron flux from beam current integration and d-d cross section data. The resulting value of 87 millibarns is estimated to be reliable within 10 per cent and is about 0.7 of the value given in the report of Marion and Brugger,³ though it falls within their quoted possible error of 40 per cent.

Microfilm \$2.00; Xerox \$3.00. 54 pages.

1. S. C. Snowdon, Phys. Rev. 78, 299 (1950).
2. Bostrom, Hudspeth and Morgan, Phys. Rev. 99 643 (A) (1955).
3. Marion and Brugger, Phys. Rev. 100, 69 (1955).

THE TRANSFER OF SOLAR RADIATION AT THE WAVE LENGTHS OF THE SODIUM D-LINES BY THE EARTH'S ATMOSPHERE

(L. C. Card No. Mic 59-2409)

Vincent Robert Stull, Ph.D.
University of Pittsburgh, 1959

An investigation of the phenomena of the presence of the sodium D-lines in the radiation from the earth's atmosphere was undertaken. The objective was to explain the presence of these lines in the twilight atmospheric radiation as resulting from solar photons of the D-line frequencies being scattered (possibly more than once) principally by atmospheric sodium and by air molecules in the lower atmosphere.

A general iterative transfer theory for a scattering atmosphere was developed, which has application to other lines as well as the sodium D-lines, and which holds at times other than twilight. A model atmosphere was designed, taking account of the effects of air, ozone, and sodium itself on the D-line radiation, to which to apply the theory. The distribution and location of the three constituents of this model were based on previous research. The interaction of the radiation with air, Rayleigh scattering; with ozone, true absorption; and with sodium, resonance scattering, were formulated so as to fit into the general formulae which had been derived. The resonance scattering process was treated in detail to include the four D-lines which result from the hyperfine splitting of the S-level of the sodium atoms.

The incident solar spectrum had to be determined in detail because of the presence of the Fraunhofer lines and secondly because of the shift of these lines with respect to terrestrial sources resulting from the gravitational and Lindholm effects and from the relative motion of the sun and the earth. This spectrum was determined semi-empirically using measurements of the Fraunhofer profiles and of the frequency shifts.

The equations for the intensity of atmosphere D-line radiation which were derived from this treatment were programmed for the IBM 650 computer. The numerical results for both the total intensity and the ratio of the intensity within the D₂ fine structure line to that within the D₁, were analysed in detail and compared to experimental measurements.

It was found that the process of the transfer of solar radiation at the frequencies of the D-lines is sufficient to explain the intensity measurements both quantitatively and in their variation throughout twilight. By comparing the theoretical and experimental results for both the total intensity and the (D₂/D₁) ratio it was possible to deduce the abundance of atmospheric sodium. Large geographical and time variations in this abundance were indicated with the ordinary range of values being 1×10^9 to 25×10^9 atoms per vertical cm² column, with much greater abundances seeming possible.

Microfilm \$2.00; Xerox \$5.40. 109 pages.

THE NUCLEON STRUCTURE AND THE ELECTROMAGNETIC FORM FACTORS

(L. C. Card No. Mic 59-2759)

Kameshwar C. Wali, Ph.D.
The University of Wisconsin, 1959

Supervisor: Professor Robert G. Sachs

The interaction of an external electromagnetic field with the nucleon provides a means of determining the nucleon charge and current distribution. One can divide this interaction in two parts, one that arises from the normal Dirac charge-current distribution and the other from the current distribution that gives rise to the anomalous magnetic moment. The finite size or the structure of the nucleon can be taken into account by introducing in each of the above interactions an invariant scalar function of ΔP^2 , where $\Delta P = P' - P$ is the four vector representing the momentum and energy change between the initial and the final state of the nucleon due to the momentum and energy transfer from a hypothetical photon. We have defined certain combinations of these invariant scalar functions as magnetic and charge form factors and have shown how they are directly related to the charge and the magnetic properties of the nucleon. Given the expression for the nucleon charge-current density in momentum space in the form $\bar{U}(P)O_\mu U(P)$, where U and \bar{U} are Dirac spinors for a free particle and O_μ is some operator involving γ -matrices and functions of P, P' , we have developed projection methods to extract the form factors for arbitrary momentum transfer ΔP . These methods are of particular importance in connection with the relativistic wave functional approach of Ernst and Sachs where one would like to obtain and compare the relative contributions of different terms like the one-pion term, the nucleon-antinucleon pair term, etc., to the electromagnetic properties of the nucleon.

The wave functional approach mentioned above is a generalization of the earlier one followed by Sachs in the application of the static model of the nucleon to the problem of nucleon structure. The new method is more general and, in particular, it enables one to take into account

nucleon recoil and nucleon-antinucleon pair effects. We have studied the connection between the conventional S-matrix approach and the wave functional approach. Having shown that the two methods are formally equivalent, we have analyzed the lowest order contribution to the electromagnetic interaction of the nucleon in the real pseudoscalar meson theory and have shown how it renders itself to a wave functional interpretation. A result of particular importance in this connection is the occurrence of a nucleon-antinucleon pair state along with the one-pion state in the wave functional corresponding to the lowest order perturbation result.

With the object of taking into consideration the higher order effects we have then considered the effect of introducing a phenomenologically generalized vertex function in the S-matrix. We have calculated the corresponding wave functional and, using the projection methods mentioned earlier, have obtained the contributions to the magnetic form factor from different terms appearing in the wave functional. The pair term contribution, in particular, is found to depend on the detailed nature of the vertex function introduced. To arrive at a qualitative

understanding of the pair term effect, we have calculated the sum of the magnetic moments of the proton and the neutron by making a simplified choice of the vertex function. The conclusions of this analysis may be summarized as follows:

- (1) The relativistic generalization of the static model necessarily introduces the nucleon-antinucleon pair state along with the one-pion state in the consideration of the iso-scalar part of the electromagnetic interaction of the nucleon.
- (2) The occurrence of the pair state removes the restriction imposed on the one-pion state by the Mirror theorem. Consequently it is possible to raise the one-pion state probability to 20 or 30% in accordance with our preconceived notions of nucleon structure and also with the photo-pion production data.
- (3) The angular correlation effects in the pair state are likely to produce large effects on the electromagnetic properties of the nucleon.

Microfilm \$2.00; Xerox \$4.40. 82 pages.

PHYSIOLOGY

NEUROHYPOPHYSEAL REGULATION OF ANTERIOR PITUITARY GONADOTROPHIC HORMONE SECRETION

(L. C. Card No. Mic 59-2460)

David Thomas Armstrong, Ph.D.
Cornell University, 1959

Oxytocin injections have been administered to immature rats, prepuberal rabbits, and normally cycling heifers to investigate the possibility that oxytocin may be one of the hypothalamic neurohumoral substances responsible for regulation of gonadotrophic hormone secretion by the anterior pituitary gland. The failure of rats to respond to treatments with increased uterine or ovarian weights or altered ovarian histology under a number of different experimental conditions indicates that if oxytocin is involved in the regulation of gonadotrophic hormone secretion in rats, it does not provide sufficient stimulus by itself to cause such secretion.

When oxytocin was administered to male rabbits over an eleven-week period, increased growth rates, testes weights, seminiferous tubule diameters, and prostate epithelial heights resulted. FSH treatment was shown to cause similar effects. Epinephrine, when administered concurrently with these hormones, prevented all responses to oxytocin but only the prostate response to FSH. Epinephrine by itself did not suppress any of these organs below the levels observed in untreated rabbits.

Oxytocin appeared to cause stimulation of the interstitial cells of the testes, suggesting a trophic action of oxytocin on the anterior pituitary resulting in secretion of an interstitial cell stimulating hormone. Epinephrine

appeared to prevent the secretion of the interstitial cell stimulating hormone, or to prevent its action on the testes.

The administration of oxytocin to heifers through the first week of the estrous cycle resulted in marked shortening of the diestral period, the next heat occurring 8 to 12 days after the previous estrus in the majority of instances. These precocious heat periods appeared normal in every respect, being followed in all cases by ovulation at the expected time. In all cases the next diestral periods were of normal lengths. Oxytocin was less effective in causing diestral shortening when atropine, or reserpine, was administered concomitantly, and was completely ineffective in inducing precocious estrus in hysterectomized cows. Although prolactin failed to override the diestrum-shortening effects of oxytocin, the observations that progesterone did prevent oxytocin-treated heifers from returning to heat as long as it was being administered, and that corpora lutea of oxytocin-treated heifers did not attain the same size as those of untreated heifers, suggested that the observed effects may have been caused by inhibition of secretion of a luteotrophic hormone from the anterior pituitary. Possible mechanisms of action of oxytocin in causing the observed alterations of the estrous cycle have been discussed.

Microfilm \$2.00; Xerox \$5.60. 112 pages.

**A DYNAMIC STUDY OF THE THERMO-
REGULATORY RESPONSES OF THE
UNANESTHETIZED DOG TO LOCAL HEATING
OF THE HYPOTHALAMUS**

(L. C. Card No. Mic 59-2232)

Madeline Mary Fusco, Ph.D.
University of Pennsylvania, 1959

Supervisor: James D. Hardy

Direct and indirect calorimetric measurements of the total thermal and metabolic responses of the conscious dog to localized heating of the preoptic region were made at a cool (14°C), neutral (26°C) and slightly warm (29°C) environmental temperature. The heating was accomplished by means of radio-frequency energy (3.7 mc) applied between implanted electrodes at the rate of 0.5-1.0 watts. Continuous and simultaneous measurements were made of oxygen consumption, surface and respiratory evaporative heat loss, total non-evaporative heat loss, hypothalamic temperatures, rectal and mean skin temperatures, during a 5-6 hour run at each of the environmental temperatures. From these quantities heat production and heat loss factors were derived and analyzed in terms of heat balance.

Central heating created a disturbance in this balance. The factors affected by the central heating were metabolic rate, vasomotor activity and evaporative heat loss. The overall effect of heating the preoptic region to 39-41°C was, at all calorimeter temperatures, a lowering of the body temperature. In a cool environment this was effected chiefly by a depression of heat production relative to heat loss; shivering was inhibited. There was no panting or vasodilation. In a neutral environment the response was a profound depression in metabolism, no panting, and slight vasodilation. In a slightly warm environment there was a pronounced increase in heat loss through panting and a slight vasodilation. In each case an elevation in heat production occurred on cessation of heating, ranging from marked in the cool, moderate in the neutral and only slight in the warm. The elevated heat production was depressed on reapplication of heat.

The behavioral responses of a normal conscious dog to localized heating of the preoptic region of the anterior hypothalamus were described and filmed. In response to mild heating the animal became very quiet, lay down, stretched out and appeared drowsy and slept. As the heating was increased the animal became alert, sat up, salivated and began to pant and continued to pant as long as the central heating was maintained. At the end of one hour of heating, thirty minutes of which was a period of sustained vigorous panting, the heat was turned off and the dog stopped panting and began to shiver vigorously. The shivering was inhibited and the panting again elicited on reapplication of heat.

These studies have shown that:

1. There are thermosensitive cells localized in the preoptic region.
2. Heating this area elicits a complex pattern of behavioral responses (relaxation, lethargy, drowsiness and sleep).
3. Depression of metabolism, vasodilation, panting and suppression of shivering can be elicited by heating this area.

4. There is a threshold temperature for each of the responses, in the following order--depression of metabolism, vasodilation and panting--which are modified by the peripheral drive.

5. The central and peripheral thermal drives interact and the thermoregulatory responses are to a summing of the two drives.

6. Central heating can markedly decrease metabolic rate. Microfilm \$2.00; Xerox \$6.40. 134 pages.

**THE CARDIOVASCULAR EFFECTS OF
ADRENALINE AND NORADRENALINE**

(L. C. Card No. Mic 59-1980)

Zora Eugenia Jasincuk Griffo, Ph.D.
The University of Buffalo, 1959

In this dissertation the cardiovascular effects of adrenaline are reexamined and compared with those produced by noradrenaline. Extensive data are presented on the systemic arterial blood pressure, heart rate, plethysmographic records of various organ volumes and ventral venous pressure in anesthetized cats.

Qualitative differences in pulse frequency are observed upon administration of adrenaline as contrasted against that of noradrenaline. This disparity, however, is small when compared on a quantitative basis.

The heart rate response, as caused by adrenaline is affected by the pre-infusion pulse frequency whereas the magnitude of the effect elicited by noradrenaline appears to depend primarily upon the initial blood pressure level.

It may be accepted that constriction occurs to a greater or lesser degree in the resistance vessels of the liver, spleen, intestine, skin and kidney whereas dilatation appears in the skeletal muscle vessels upon administration of both adrenaline and noradrenaline.

It is noted in this research that while the dilator effect of noradrenaline on the skeletal muscle vessels is always of the same magnitude, adrenaline causes a greater or lesser response depending upon the initial state of the vessels.

The present data show that both adrenaline and noradrenaline cause emptying of the venous capacity vessels in the skeletal muscle, liver and spleen; adrenaline being the more potent of the two. On the other hand, blood is passively accumulated in the small intestine; this effect is also greater upon administration of adrenaline than noradrenaline.

The central venous pressure is slightly elevated with both adrenaline and noradrenaline.

The systemic arterial blood pressure invariably exhibits a strong pressor effect both systolic and diastolic with noradrenaline. Adrenaline elicits a rise of the systolic pressure while the diastolic may show a decline, no change or a pure rise. The latter response correlates well with the effects observed in the skeletal muscle vessels which in turn depends upon their initial state.

The difference in magnitude between the pressor response caused by adrenaline and noradrenaline cannot be entirely explained by qualitatively dissimilar effects on heart rate or skeletal muscle blood vessels or by quantitatively different actions on the resistance and capacitance vessels in the remaining vascular beds.

It is suggested that a qualitatively different effect upon the aorta and large arteries may to a great extent be responsible for the observed discrepancy of the pressor response between adrenaline and noradrenaline.

Microfilm \$2.00; Xerox \$7.20. 151 pages.

LIBIDO, SPERM CHARACTERISTICS, SPERM OUTPUT, AND FERTILITY OF MATURE DAIRY BULLS EJACULATED AT DAILY OR WEEKLY INTERVALS FOR THIRTY-TWO WEEKS

(L. C. Card No. Mic 59-2466)

Harold David Hafs, Ph.D.
Cornell University, 1959

Dairy bulls in artificial breeding organizations in the United States are usually ejaculated once a week. Although, at this interval, enough semen is usually obtained to breed 900 to 1400 cows a week, these numbers are small relative to the increasing demands for matings to superior sires.

There are several reports in the literature comparing sperm output of bulls ejaculated at frequencies of from three ejaculates every eighteenth day to as often as four ejaculates a day and all of these support the hypothesis that many more sperm may be obtained by ejaculating bulls more often than once a week. However, none of these reports give much information about the effects of prolonged frequent ejaculation on sperm output and fertility.

The study reported in this thesis was undertaken to determine the effects of daily ejaculation upon the libido, sperm output, sperm characteristics, fertility, and physical well-being of mature dairy bulls. This frequency of ejaculation was chosen as a method of applying stress upon bulls' sperm producing capabilities and to ascertain whether or not, mature bulls can withstand daily ejaculation for as long as eight months.

Six aged dairy bulls in the breeding stud of the New York Artificial Breeders' Cooperative were chosen for this study and were ejaculated once a week for a four week preliminary period, after which three were chosen at random to be ejaculated once a day and three once a week. The results of the preliminary period indicated that the experimental period averages needed no covariance adjustments.

The 32 week experimental period permitted 224 possible ejaculates from each of the three bulls on the daily frequency of ejaculation and 32 from each of the three bulls on the weekly frequency. The bulls ejaculated once a week yielded an average of 8.35 milliliters of semen per ejaculate, 63 percent motile sperm, 1.71 billion sperm per milliliter of semen, 8.87 billion motile sperm per ejaculate, and 13.97 billion total sperm per ejaculate. The bulls ejaculated once a day yielded an average of 5.47 milliliters of semen per ejaculate, 69 percent motile sperm, 0.85 billion sperm per milliliter of semen, 3.26 billion motile sperm per ejaculate, and 4.64 billion total sperm per ejaculate. On a per week basis the daily bulls yielded an average of 22.79 billion motile sperm and 32.48 billion total sperm. The differences in these sperm output criteria between the two ejaculation frequencies were

all statistically significant except that for percent motile sperm.

The averages of the pH of the fresh unextended semen, the vital staining properties of the sperm, the morphological abnormalities of the sperm, and the percent of motile sperm after 1, 4, and 8 days storage at 5°C. in the standard Yolk-Citrate extender and two experimental room temperature extenders and after 1, 60, and 120 days storage at -79°C. revealed no significant differences between the two frequencies of ejaculation.

The fertility of the semen, measured by the percent of cows not returning to service within 60 to 90 days after first insemination, was 75 % for 5,354 inseminations with semen from the bulls ejaculated daily and 67 % for 15,596 inseminations with semen from the bulls ejaculated weekly. The difference was not statistically significant ($P > .05$).

The bulls ejaculated daily required an average of 14.7 minutes of sexual preparation and 3.9 mounts before each ejaculation, as compared to an average of 9.9 minutes and 3.1 mounts for the bulls ejaculated weekly.

The results of this experiment indicate that daily ejaculation for as long as eight months is not harmful, either to the bull itself or to the livability and fertility of the sperm it produces.

Microfilm \$2.00; Xerox \$3.00. 51 pages.

ACCELERATION OF THE AEROBIC RESPIRATION OF PLANTS BY LIGHT

(L. C. Card No. Mic 59-1907)

George Keithley Harrison, Ph.D.
University of Maryland, 1958

Supervisor: Dr. Hugh G. Gauch

As compared with darkness, white fluorescent light (800 f.c.) accelerated the oxygen uptake of carrot discs, potato tuber discs, and yeast suspensions -- tissues and cells generally agreed to have cytochrome oxidase as the main terminal enzyme.

Determinations of respiratory quotients for carrot indicated that there was no significant difference between illuminated discs and controls in darkness. Inasmuch as there was an increase of carbon dioxide evolution corresponding to the increase of oxygen absorption in the light, as compared with darkness, the phenomenon was deemed to be metabolic, proceeding through a normal respiratory pathway.

The light-accelerated respiratory effect was minimized or almost nullified by malonate. It was therefore suggested that the light-stimulated effect involves the succinic dehydrogenase-cytochrome oxidase pathway.

In the incipient stage, the light effect was found to be reversible when darkened controls were illuminated and discs which had previously been illuminated were placed in darkness. However, under prolonged illumination of 150 f.c. the light-stimulatory effect was found to persist for at least eight hours in darkness.

Sodium azide completely nullified the light-stimulated respiration in carrot. This is considered additional evidence that the phenomenon acts through the normal cytochrome oxidase.

Carrot discs varied with respect to the magnitude of the light-accelerated respiration. The respiration of some samples of discs was initially much accelerated by light whereas that of others was initially only slightly so. Carrot discs of the latter type became progressively more responsive to light if kept in darkness in a water-vapor-saturated chamber at 25° C for a period of from one to three days. Furthermore, it was found that carrot discs which were inhibited with 0.06 M succinic acid or 500 ppm boron (as boric acid) would show accelerated oxygen uptake when illuminated, while untreated discs showed little or no "light effect". Other substrates did not initiate or augment the light-stimulated respiration.

The experimental findings noted above, together with the findings of previous investigators, suggested that the effect involves a light-accelerated oxidation of succinic acid and possibly fatty acids through the succinic dehydrogenase-cytochrome oxidase pathway. A mechanism was proposed which indicated that the magnitude of the light stimulated respiration was a function of substrate competition between the succinic dehydrogenase-cytochrome oxidase pathway and that of other substrates transferring hydrogen via the coenzymes. The competitive advantage is altered in favor of the succinic dehydrogenase-cytochrome oxidase chain when the pathway requiring the coenzymes is inhibited in some manner such as by a drop in the phosphorylative oxidation of the reduced phosphopyridine nucleotides or when extra succinic acid is supplied to the tissue.

The results are discussed in relation to the findings of other investigators.

Microfilm \$2.00; Xerox \$3.00. 50 pages.

PHYSIOLOGICAL AND BIOCHEMICAL ADAPTATION OF GOLDFISH TO COLD AND WARM TEMPERATURES

(L. C. Card No. Mic 59-2030)

Madhu Sudan Kanungo, Ph.D.
University of Illinois, 1959

Measurements of the standard and active metabolism of goldfish (*Carassius auratus*) acclimated to 10° and 30° C were made at 10°, 15°, 20°, 25°, 30° and 32° C. The temperature for the maximum standard and active metabolism and for the maximum difference between the standard and active metabolism was 25° C for the cold-acclimated and 30° C for the warm-acclimated fish. The curves for the standard and active metabolism of each group of fish were parallel. Hence, it is suggested that the goldfish utilizes the same pathway of metabolism for both the standard and active metabolism. Translation of the rate-temperature curves to the left occurred on cold-acclimation so that the standard and active metabolism at 20° C were respectively 26% and 16% greater than those of warm-acclimated fish. The Q_{10} for the cold-acclimated fish decreased at higher temperatures faster than that of warm-acclimated fish. Hence, the R/T curves for the standard and active metabolism of the cold-acclimated fish intersect at 27° C with those of warm-acclimated fish. Thus, the acclimation of goldfish to temperature occurs according to Pattern II_A of Prosser (1958).

When expressed as the percentage of wet weight, the dry weight of the liver of cold-acclimated fish was 4.7% greater than that of warm-acclimated fish. When the substrate was glucose plus succinate, the Q_{O_2} at 20° C for the liver homogenate of cold-acclimated fish was 43% higher than that of warm-acclimated fish. The $Q_{O_2}^N$ for the mitochondria of cold-acclimated fish was 12% higher than that of warm-acclimated fish. Hence, it is suggested that the 31% difference in oxygen consumption by the liver homogenate not attributable to mitochondria is by way of the hexosemonophosphate pathway.

Amytal, azide, cyanide and carbon monoxide inhibited the respiration of liver homogenates, but the percent difference between the two groups of animals was not statistically significant. Carbon monoxide inhibited 50% of respiration in both the groups of fish. Hence, it is likely that 50% of respiration occurs through non-cytochrome oxidase pathways. The percent inhibition of respiration of liver homogenates by antimycin was significantly higher for the cold-acclimated fish.

Oxidative phosphorylation by the liver mitochondria of both groups of fish was measured at 20° C with succinate, malate, isocitrate and α -ketoglutarate. The P/O ratio and μ M Pi/mg. Protein values were significantly higher for the warm-acclimated fish. The $Q_{O_2}^N$ values were slightly higher for the cold-acclimated fish. It is probable that the low P/O ratio in cold-acclimated fish mitochondria is due to a decrease in activity of the phosphorylating system, whereas the dehydrogenases for the Krebs cycle intermediates are not greatly altered in activity. Possible causes for decreased phosphorylation in cold-acclimation could be a shift from the DPN-Flavin-Cytochrome c pathway to a TPN-Cytochrome c pathway which is less phosphorylating, or else the presence of some inhibitor like thyroxine.

On the basis of approximately theoretical P/O ratios obtained from mitochondria with the four substrates and the inhibition of respiration of liver homogenate by antimycin, amytal and carbon monoxide, it is suggested that a full complement of cytochrome system linked to pyridinenucleotide and flavin is present in fish liver mitochondria and that the Krebs cycle intermediates are utilized effectively.

It is concluded that metabolic adaptation to temperature occurs in the goldfish at the cellular level by quantitative changes of several enzyme systems.

Microfilm \$2.00; Xerox \$4.00. 74 pages.

STUDIES OF THE BEHAVIOR OF COMPLETELY ISOLATED MAMMALIAN KIDNEYS PERFUSED WITH BLOOD IN AN ENTIRELY MECHANICAL CIRCUIT; RENAL VASCULAR PRESSURE-FLOW RELATIONS.

(L. C. Card No. Mic 59-2292)

Alfred Theodore Kornfield, Ph.D.
The Ohio State University, 1953

A brief historical review of the literature on perfused kidney preparations is presented. This includes work on explants, heart-lung-kidneys, and pump-lung-kidneys.

Descriptions are provided of various items of apparatus and arrangements necessary to maintain an adequate and completely isolated blood perfusion system for mammalian kidneys. These items include:

1. a valveless pump, in which blood is propelled rhythmically through plastic tubing by the sequential compression action of a series of metal fingers;
2. a blood distributing manifold, designed by the writer, to meet requirements for a single compact device placed between pump and kidney in which blood temperature and pressure could be detected and flow could be divided between the kidney and a by-pass;
3. a blood temperature measurement system, designed by the writer, comprised of thermistor probe and bridge-indicator network;
4. a dynamic blood pressure pickup, designed by the writer;
5. a blood oxygenator-reservoir, designed by the writer, in which renal venous blood flows into a trough, then down a stainless steel grid into a reservoir chamber; and
6. a special heating system of Fiberglas heating tape helically wound on small diameter plastic tubing.

This perfusion system has the following characteristics: 1. mean pressure range: 0-300 mm.Hg. 2. pulse pressure range: 0-2 times the mean pressure. 3. pulse rate range: 20/min. - 300/min. 4. pump flow rate range: 0-600 cc./min. 5. temperature range: ambient to $41^{\circ} \pm 0.1^{\circ}$ C. 6. oxygenation range: 0 - 100 %.

Descriptions are also provided of the preparations of chemicals and animals for the experiments, and of the conduct of the experiment. Also described are the chemical and physical measurements and analyses conducted. These include: 1. arterial pressure, 2. venous outflow rate, 3. urine flow rate, 4. hematocrit, 5. specific gravity, plasma and urine, 6. oxygen saturation and capacity, 7. pH, plasma and urine, 8. hemoglobin, plasma and urine, 9. sodium, plasma and urine, 10. potassium, plasma and urine, 11. urea, plasma and urine, 12. creatinine, plasma and urine.

Evaluation was made by these analytic methods of the chemical and mechanical factors concerned with the perfusion. Evaluation was made terminally of kidney vitality by the use of adrenalin, then of potassium cyanide.

Using such experimental arrangements, fourteen experiments were conducted in which arterial pressure-venous outflow conditions were explored over a physiological range of pressures.

A linear relation of mean pressure and flow was found, indicating a constant renal resistance which was independent of mean pressure, pulse pressure, and pulse rate. The mean value for this resistance was 0.43×10^5 dyne-sec.-cm.⁻⁵. A value of resistance incorporating renal weight was also obtained of 2.77×10^6 dyne-sec.-gm.-cm.⁻⁵.

The relationship of this finding to the findings in literature on the subject is discussed. Also considered are the influences of other factors which were taken into account in these perfusions. These include: hormonal environment, general anesthetics, denervation and novocaine, renal oxygen consumption, cyanide infusion, perfusion temperature, intrarenal pressure, perfusing medium, and anticoagulants.

Microfilm \$2.75; Xerox \$9.60. 212 pages.

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THE UPTAKE AND FATE OF RADIOACTIVE ELEMENTS IN TRYPONOSOMA EQUIPERDUM

(L. C. Card No. Mic 59-1985)

Philip Francis Mulvey Jr., Ph.D.
The University of Buffalo, 1959

Trypanosomes have been studied so far exclusively from the taxonomic and cytological viewpoints; data on their chemical physiology, especially ion accumulation is as yet unavailable. Since little is known concerning ion uptake and turnover in *T. equiperdum*, the intent of this investigation was to evaluate the selective efficiency of the organism in the accumulation and leakage of certain metabolically important ions, namely sodium, phosphorus and iron. Also an attempt was made to determine those factors important in ion uptake and leakage. The factors considered were: age of the organisms, population density, and presence and absence of glucose in the medium. The use of certain metabolic inhibitors was also employed in attempts to indicate the mechanism of ion movement. A series of oxygen consumption studies was also undertaken in order to determine the relative rate of utilization of glucose as compared to other carbohydrates, since glucose was the energy source in the medium.

The strain of organisms was maintained by injecting infected blood from an adult albino rat into two or more normal rats simultaneously every day. In nearly every case, after two days of infection, the blood was swarming with trypanosomes.

The Warburg experiments indicated that oxygen consumption is coupled with the utilization of glucose, and in its absence no measurable quantity of O₂ consumption is recorded. The Q_{o2} studies also revealed that *T. equiperdum* is able to utilize xylose, fructose, mannose, sucrose, maltose, and lactose, but not as efficiently as glucose. The age of the parasite was found to affect its oxygen consumption level. A 12 hour culture consumed less oxygen per organism than an older culture. The sex of the host appeared to have no influence on the organism with respect to its oxygen consumption at 37° C. The concentration of organisms per vessel was found to have a marked affect on oxygen consumption per organism. The isotope experiments showed that the processes of ion accumulation and release are different depending on whether the organisms were suspended in a medium in the presence or absence of glucose. In an endogenous medium, the uptake of Na²² and P³² was not inhibited by metabolic poisons and, therefore, is considered to be a physical process, namely diffusion. In an exogenous medium, the uptake of Na²², P³², and Fe⁵⁵⁻⁵⁹ was inhibited by both 2,4-dinitrophenol and phenylmercuric acetate. The uptake process in the presence of glucose was temperature sensitive.

The theory which appears to be in best agreement with most of the results is that ion accumulation in the presence of glucose is an active process involving enzymatic processes and requiring metabolic energy. A carrier system may well be involved in the active process; that is, the radioactive ions are taken into the cell by means of combination of the ion and a carrier on the surface of the cell. Following the union of carrier with the transported ion there is the passage of the complex across the membrane into the cytoplasm. Splitting of the complex with release of the transported ion and the carrier then occurs,

followed by a release of energy necessary for the work involved. This is followed by the return of the carrier agent across the membrane with restoration to its original form. The intracellular ion is then either 'free' in the cytoplasm or 'bound' by the cytoplasm.

When the radioactive organisms were placed in a non-radioactive medium lacking glucose, there was a rapid release of the ions from the organisms. This release mechanism is not inhibited by metabolic poisons, and is not temperature sensitive. Thus, the efflux of the ion appears to be by diffusion. In the presence of glucose, the efflux of the ion was blocked by both dinitrophenol and phenylmercuric acetate, and the process is temperature sensitive. This process now appears to be active and might involve an exchange process.

The concentration of organisms in an exogenous medium has a direct influence on the amount of ion taken up per organism. Changes in the extracellular pH also influence the process of ion movement in *T. equiperdum*. In summary, the results of these investigations appear as follows:

- In the presence of glucose there is an active uptake and release process involving enzymatic processes and requiring metabolic energy.
- In an endogenous medium, the uptake and release process appears to be by diffusion.

Microfilm \$2.00; Xerox \$5.00. 100 pages.

EFFECT OF CHANGES IN PULMONARY BLOOD PRESSURE AND FLOW ON THE CAPILLARY BED OF ISOLATED CAT LUNGS USING THE DIFFUSING CAPACITY FOR CARBON MONOXIDE AS AN INDEX OF ITS SIZE

(L. C. Card No. Mic 59-2263)

Edith Esther Rosenberg, Ph.D.
University of Pennsylvania, 1959

Supervisor: Robert E. Forster

The relative importance of variations in blood pressure and flow on the pulmonary capillary bed was investigated, the pulmonary capillary bed being defined as consisting of all blood vessels through whose walls gas exchange takes place. The diffusing capacity of the lungs for carbon monoxide (D_L) is considered an index of the size of the total pulmonary capillary bed; increases in D_L are taken as indications that the size of the bed has increased and decreases in D_L to mean decreases in it.

Isolated cat lungs were perfused with the animal's own blood at 37°C, via cannulae in the pulmonary artery and left atrium, and ventilated by negative pressure. D_L was measured at constant volume by a modification of the single breath technique (*J. Clin. Invest.* 33:1135, 1954). Pulmonary blood flow was varied by altering the rate of the blood pump; intravascular pressures, as referred to atmospheric, were varied by changing the outflow pressure.

In 3 lungs in which the pulmonary blood flow was increased from 50 to 225 ml/min while outflow pressure was held constant, D_L increased on the average by 50%. Mean intravascular pressure, taken as the average of

pulmonary arterial and left atrial pressures, increased with the blood flow in these experiments. Raising mean intravascular pressure in 4 lungs by increasing outflow pressure at constant blood flow increased D_L on the average by about 30% per 10 mm increase in pressure. In 4 experiments in which outflow pressure was lowered while blood flow was increased there was no demonstrable increase in D_L .

We conclude that the pressure across the walls of the pulmonary blood vessels is a primary factor in controlling the size of the pulmonary capillary bed as measured by D_L . No independent effect of flow was observed.

Microfilm \$2.00; Xerox \$3.00. 54 pages.

A STUDY OF THE BOVINE ELECTROCARDIOGRAM IN HYPERVITAMINOSIS D AND TRAUMATIC PERICARDITIS

(L. C. Card No. Mic 59-2322)

Charles Roger Smith, Ph.D.
The Ohio State University, 1953

Milk fever in dairy cattle is primarily a problem of calcium metabolism. Hibbs, et al,¹ have investigated the possible role of vitamin D in its prevention. A major portion of the present study was undertaken to determine the effect of the administration of large amounts of vitamin D on the bovine electrocardiogram.

A pilot experiment on bovine traumatic pericarditis was conducted. Two experimentally induced and one naturally occurring case of traumatic pericarditis were studied electrocardiographically.

In addition to the conventional extremity leads described by Alfredson and Sykes,² a bipolar precordial lead used by Lautenschlager, ten unipolar precordial leads, and three unipolar limb leads were registered. For the precordial leads, five positions on each side of the chest in the fifth intercostal space were selected. A unipolar cervical lead was also recorded in most instances.

Nine mature Jersey cows were given excessive amounts of vitamin D. The preparation used was irradiated ergosterol; the agent was supplied by the Gelatin Products Division of the R. P. Scherer Corporation, Detroit, Michigan. The preparation contains one million units of vitamin D activity in a linseed oil base. Thirty million units were administered per os daily. The amount given per day remained constant throughout the experiment. The number of days the administration of vitamin D was continued was the only variable.

Two Hereford heifers, approximately ten months of age, were used for the experiment involving the study of artificially induced traumatic pericarditis. Rumen fistulas were established. Several months after establishing a fistula, pericarditis was induced in each animal by introducing a thin, septic wire into the pericardial sac via the rumen and reticulum. The wire, used to simulate the manner in which clinically occurring cases originate, was withdrawn after a 20 to 30 second interval.

A third animal, this one a spontaneously occurring case of traumatic pericarditis, was also studied electrocardiographically. A thin wire penetrating the reticular wall had been removed surgically the day prior to the

first electrocardiographic examination. The operator had observed a rhythmical pulsation of the wire before its removal.

The electrocardiograms in the vitamin D experiment.—The electrocardiographic signs indicative of a change in the heart of the animals given vitamin D varied in each of the experimental animals. Five of the cows received 30 million units of vitamin D per day for periods ranging from 25 to 33 days. In each case premature ventricular systoles occurred during the observation period. This was the most common abnormality encountered. There was considerable variation between animals in this group as to the manifestation of other cardiac abnormalities. One cow developed a temporary auricular fibrillation 18 days after the beginning of vitamin D administration. Another cow showed a peculiar short P-R interval combined with an abnormally shaped QRS complex 26 days following cessation of vitamin D administration. This abnormality was also recorded 43 days following cessation of administration. The third cow in this group developed frequently occurring premature ventricular systoles after 25 days of vitamin D administration. The condition resembled that referred to as "chaos of the heart" by Katz.³ The first definite cardiac abnormality noted in the fourth cow was the appearance of ventricular premature systoles 23 days after the beginning of vitamin D administration. The first ventricular premature systole was detected in the fifth cow 24 days after the beginning of vitamin D administration.

One cow was given vitamin D for a period of 23 days. No definite cardiac abnormalities were detected in any of the 18 electrocardiographic examinations made.

One cow was given vitamin D for 21 days. Ventricular premature systoles appeared 15 days following the beginning of administration. Their frequency increased and evidence of multiple sites of the origin of these abnormal complexes appeared by the end of the observation period.

Four cows received an amount of vitamin D varying between 230 million and 300 million units over a 7 to 10 day period. Three animals failed to show any change in the electrocardiograms recorded. In one of the animals given vitamin D for 7 days, one ventricular premature systole was recorded on the last day of administration.

In this study nearly all known types of ventricular premature systoles were recorded. Bidirectional, paired, unifocal, multifocal, occasional and frequent, and interpolated ventricular premature systoles were encountered. One animal showed premature auricular systoles. The fact that premature ventricular systoles never occurred in the control electrocardiograms of any animals included in this experiment leads one to believe that their appearance is associated with a disease process. This is further substantiated by the fact that ventricular premature systoles were not found in any of the normal cattle examined by either Sporri,⁴ or Alfredson and Sykes.²

A discussion of the occurrence of auricular fibrillation in the cow was not found in literature in the field. Its occurrence in the study is considered an abnormality.

Two cases of the Wolff-Parkinson-White Syndrome have been described by Sporri,⁵ in cows which were otherwise apparently normal. The cases described showed complexes which differed from the short P-R interval syndrome encountered in study in two ways: the QRS com-

plexes were not abnormally prolonged, and the P-J intervals were much shorter than average.

The R-R, P-R, and Q-T intervals were measured in both the bipolar precordial lead and in lead II. The duration of the QRS complex was also measured in the two leads. The systolic index was calculated separately from values obtained from both leads. No abnormalities involving the duration of any of the intervals referred to were discovered.

Of the various abnormalities recorded, arrhythmias were encountered most frequently. The types found were: (1) bradycardia, (2) nonphasic sinus arrhythmia, (3) ventricular premature systoles, (4) auricular fibrillation, (5) chaotic heart action, (6) auricular premature systoles, and (7) a syndrome characterized by a short P-R interval with an abnormal QRS complex.

Abnormalities of wave configuration were infrequently encountered. One of the animals given vitamin D for 32 consecutive days showed a markedly changed ventricular complex in the records made by using both bipolar precordial lead and the unipolar lead originating from the apical area on the left side of the chest. In the bipolar lead the QRS complex changed from an rS type to an equiphasic RS type. In the bipolar lead this complex changed from a QS type to an upright Rs type.

The electrocardiogram in traumatic pericarditis.—Five electrocardiographic examinations were made prior to the induction of septic puncture of the pericardial sac. Twenty additional examinations were made during a 60 day period following puncture of the pericardium. Eighteen leads were used.

One of the two heifers previously referred to showed a characteristic change in the configuration of the ventricular complex. The change was clearly discernible 12 days after pericardial puncture. The changes consisted of a displacement of the S-T junction and S-T segment, and an alteration in the form of the T wave. The changes were most evident in leads II, III, aVl, and aVf. In leads II and III, the S-T junction and S-T segment were displaced upward slightly. The summits of the waves lost their pointed nature; they became very broad. The summits of the T waves in leads aVl and aVf also assumed a broad outline similar to those in leads II and III. Downward displacement of the S-T junction and S-T segment occurred in the bipolar precordial lead and in the unipolar precordial lead recorded from the cardiac apical region on the left side of the chest. The changes described persisted for about 6 days; shortly thereafter the changes gradually regressed. Sixty days after pericardial puncture the electrocardiograms had returned to normal.

The other animal subjected to experimental pericardial puncture did not show the changes similar to those already described. A phasic sinus arrhythmia appeared a day after pericardial puncture. This condition disappeared 3 days later. During the interval when the condition of arrhythmia prevailed, the potential of the ventricular deflections increased in the bipolar precordial lead and in the unipolar precordial lead recorded from the cardiac apical region on the left side of the chest.

The clinical, or spontaneously occurring case of traumatic pericarditis produced a record illustrative of a partial heart block the first day after surgical removal of the wire which caused the condition. Some portions of

the records show a regular 6:5 A-V block. Other sections reveal only an occasional dropped, or skipped, heart beat. Electrocardiograms obtained one week later showed an elevation of the S-T junction and the S-T segment and a rounding of the summit of the T wave in lead III. This animal was released to its owner in apparent good health several days later.

A post-mortem examination of the two experimentally induced traumatic pericarditis cases revealed only a small area of fibrosis on the parietal layer of the pericardium in each animal. Microscopic section of the heart of one revealed a small area of fibrosis and lymphocytic infiltration in the myocardium in the apical region of the left ventricle.

The diagnosis of chronic traumatic pericarditis in the bovine is not difficult. The disease is usually well advanced, the clinical signs conspicuous, and the prognosis unfavorable at the time the affected animal is presented for diagnosis to the veterinarian. Clinical experience and the results of this experiment indicate that early diagnosis and subsequent treatment of the disease can dramatically alter the course of the condition.

The results of this experimental electrocardiographic study indicate that the use of the electrocardiograph may be employed advantageously in animals suspected of being affected with traumatic pericarditis.

Summary

1. The results of the electrocardiographic study of both the induced vitamin D toxicity in the bovine and the bovine traumatic pericarditis experiment indicate that the use of both multiple precordial leads and the standard extremity leads is preferable to the use of either extremity or precordial leads alone.

2. Evidence is presented to show that electrocardiographic abnormalities are seen when hypervitaminosis D

occurs in the bovine. The first electrocardiographic change was detected after the administration of the seventh daily 30 million unit dose of vitamin D administration was discontinued.

3. Arrhythmias were the most frequently encountered electrocardiographic abnormalities appearing in cows receiving vitamin D. Premature ventricular systoles occurred in every animal in which deviations from normal occurred in the electrocardiogram. Auricular fibrillation, auricular premature systoles, bradycardia, nonphasic sinus arrhythmia, and a condition resembling the Wolff-Parkinson-White Syndrome were found in animals manifesting signs of hypervitaminosis D.

4. The electrocardiographic findings of two experimentally induced cases and of one naturally occurring case of bovine traumatic pericarditis are presented.

Microfilm \$2.95; Xerox \$10.20. 228 pages.

1. Hibbs, J. W., Krauss, W. E., Monroe, C. F., and Sutton, T. S. "Studies on Milk Fever in Dairy Cows. I. The Possible Role of Vitamin D in Milk Fever," *J. Dairy Science*, 29 (1946), pp. 617-23.

2. Alfredson, B. V., and Sykes, J. F. "Electrocardiograph Studies in Normal Dairy Cattle," *J. Agr. Res.*, 65 (1942), pp. 61-87

3. Katz, Louis N. *Electrocardiography*. 2nd ed. Philadelphia: Lea and Febiger, 1946.

4. Sporri, H. "Der Einfluss der Tuberkulose auf das Elektrokardiogramm, Untersuchungen an Meerschweinchen und Rindern," *Arch. wiss. u. prakt. Tierheilk.*, 79 (1944), pp. 1-57.

5. Sporri, H. "Der Ersten Falle von Sog. Wolff-Parkinson-White Syndrome, einer eigenartigen Herzanomalie bei Tieren," *Schweiz. Arch. Tierheilk.*, 95 (1953) pp. 13-22.

Abstract published by special arrangement with The Ohio State University.

POLITICAL SCIENCE

POLITICAL SCIENCE, GENERAL

NEO-FREUDIAN MATERIALS FOR A POLITICAL PHILOSOPHY

(L. C. Card No. Mic 59-1809)

Martin Birnbach, Ph.D.
Rutgers University, 1959

Major Professor: Edward McN. Burns

The questions of how and to what extent human beings are molded by their social environment, and how people can be expected to act in a political context, are matters that have agitated political philosophy from the beginning. The light thrown on them by the method formulated by Sigmund Freud, psychoanalysis, has equalled the heat generated by his more venturesome excursions into social philosophy. Both aspects of his work have been modified by the Neo-Freudian school of analysts -- Franz Alexander, Erich Fromm, Karen Horney, Abram Kardiner, and Harry Stack Sullivan. This dissertation explores the writings of the Neo-Freudians in a search for materials that can be of use to contemporary American political philosophy.

In revising Freudian psychology so as to take greater account of the data contributed by the social sciences as well as better to attune psychoanalysis to the conditions of American life, the Neo-Freudians have undertaken conceptual innovations that may be summarized by their vocabulary. Such are adaptation to the environment (as opposed to instincts), life experiences (rather than libido), the total personality (and not id-psychology), and authority and subordination (rather than sexuality). Withal, the Neo-Freudians retain the significance of the unconscious, of the interpretation of dreams, of the Oedipus complex, and of infantile experiences.

Thus equipped, the Neo-Freudians proffer a concept of character structure as the product of the impact of social institutions on the individual, notably as they are channelled by the family in his early years. As an unconscious, but nonetheless potent, source of behavior, character structure frequently contains the germs of mental illness, in that it may stunt the individual's capacity for growth toward a stable self-system. Inner conflicts may be precipitated when impregnated values do not accord with social realities and have to be repressed. In Western society, the Neo-Freudians have found mental illness to be the upshot of a train of causation that can be traced backward from insecurity and anxiety, to competition, to the quest for individual self-validation, the latter the consequence of a long-term evolution of social institutions dating from the Renaissance and the Reformation.

It is noteworthy that the Neo-Freudians suggest mental health as a supreme value to be considered by the social sciences, a value not hitherto sufficiently appreciated by American political philosophy despite the assumption that democratic, constitutional government depends

upon mature, rational citizens. Neo-Freudian studies of widespread psychopathology, ranging from crime and juvenile delinquency to racial discrimination and the more pervasive loss of individual spontaneity and productivity, illuminate the social and individual tragedies of mental illness.

If social malaise and individual suffering are problems with which political philosophy ought to be concerned, the Neo-Freudians also suggest an approach for the application of remedial measures. Therapy, rather than doctrinaire political programs, prevention, rather than cure, are seen to be the desired techniques. In this connection, the politics of prevention proposed by Harold D. Lasswell is given consideration and found to hold promise for the future, however difficult of practical application. Lasswell's early writings, representing the single sustained attempt to apply Freudian psychology to politics, are examined and the limitations of this approach discussed. Among the Neo-Freudians proper, Erich Fromm's contention that a wholesale revamping of social institutions is a necessary prelude to eradicating social ills is criticized and rejected in favor of the less ambitious determination of his colleagues to work within the limits of current institutions in resolving the psychic conflicts that lie at the root of our problems.

Microfilm \$4.25; Xerox \$14.40. 331 pages.

THE SENATE COMMITTEE ON FOREIGN RELATIONS: A STUDY OF THE DECISION-MAKING PROCESS

(L. C. Card No. Mic 59-2018)

David Nelson Farnsworth, Ph.D.
University of Illinois, 1959

The subject of this study is the Senate Foreign Relations Committee from 1947 to 1956--the Eightieth through the Eighty-fourth Congresses. This study is organized in the following fashion. First, the author attempts to state his assumptions concerning the political process and how these assumptions are related to the Foreign Relations Committee. The second part, the bulk of the study, relates to the major areas of policy-making relegated to the Committee by traditional practice and the Legislative Reorganization Act of 1946. These areas are 1) nominations of personnel that are related to foreign affairs. The subject of nominations before the Committee is discussed by contrasting the Committee's treatment of routine nominations with those that are controversial. 2) The Committee's treatment of treaties is analyzed at some length with special emphasis placed on the peace and security treaties that came before the Committee during this ten-year period. 3) A study is made of the Committee's attitude toward the foreign aid program and how this program fared in the Committee. 4) A review is made of legislation

of a general nature that is not annually recurrent, such as investigations. Thirdly, an effort is made to assess the Committee's relationship with the Executive branch and, with greater emphasis, the behavior of the Committee's membership on the floor of the Senate. The study, of course, concludes with a chapter devoted to drawing some conclusions which result from the research.

This study assumes that the Foreign Relations Committee is a formal decision-making agency in which conflicts between groups are resolved. Based on this assumption it is found that the Committee itself acts as an interest, not only in its dealings with the Executive and the Senate, but also with private organizations and other Congressional committees. The concept of access as developed by David Truman is also an important element in this study. The Committee as a means of access to the decision-making process for private organizations is evaluated at some length.

Since the principal source of research data are the printed Committee hearings, the emphasis in this study is upon the role played in decision-making by the public hearings held by the Committee. The conclusion that results from this investigation is that hearings are held for a variety of reasons such as a technique to relieve pressure from private organizations and as a means of selling legislation to the Senate and the public, but hearings are seldom held for the purpose of gathering the information on which the Committee will base its decision. The one generalization that seems to be most clearly developed in this study is that all major changes in legislation and/or the decision to pass or reject legislation are made before the public hearings are held. Only minor amendments are approved during and after the hearings.

Microfilm \$4.25; Xerox \$14.40. 332 pages.

THE IMPACT OF FEDERAL GRANTS-IN-AID ON CERTAIN ASPECTS OF TEXAS STATE GOVERNMENT

(L. C. Card No. Mic 59-2484)

William Mell Griffin, Ph.D.
The University of Texas, 1959

Supervisor: Professor J. Alton Burdine

The increasing importance of federal grants-in-aid as a source of state government revenue and an instrument of federal control is one of the most significant modern developments in American state government. In 1954, Congress enacted legislation which authorized the President to appoint a commission to study the problems of federal-state relations. The Commission on Intergovernmental Relations, very early in its deliberations, decided that a study of the impact of federal grants-in-aid on state governments was necessary before any general recommendations could be made on this aspect of intergovernmental relations. Several states were chosen by the Commission for special impact studies. Selection of the states was based on such factors as geographical location, population, per capita income and type of governmental organization. Texas was not one of the states selected by the Commission and this study represents an effort to add

to the information compiled on the impact of federal grants on state governments.

Chapter I of this dissertation is a historical survey of federal-state relations with special emphasis on the development of grants-in-aid. Included is a general discussion of the types of grants, methods of allocation and the fiscal significance of federal aid.

This study is limited to four of the major functions of Texas state government: highway construction, public welfare, employment security and health. These four activities account for well over half of the total federal funds received by the state and contain representative examples of almost all types of grant programs. In addition to an evaluation of the administrative and fiscal impact of federal grants-in-aid on these four functions, special attention is given to the legal developments and state-federal relationships in the actual administration of the programs.

One chapter of the study is devoted to the overall fiscal impact which the federal grants have had on state government in Texas. Both federal and state fiscal data is utilized to illustrate the effect of federal funds on the tax structure, expenditure patterns and fiscal administration of the state. Some evaluation is made of the need for continuation of federal aid and the possible consequence which might result from abolition of existing grant programs.

The final chapter includes some general conclusions in respect to the impact of federal grants on administration and fiscal policies of the Texas state government.

A large part of the material for this study was obtained by personal interviews with state and federal administrative officials. Records, reports and publications of the state and federal agencies were supplemented by descriptive articles and books on subjects relative to this dissertation. Microfilm \$4.55; Xerox \$15.40. 356 pages.

POLITICAL SCIENCE, INTERNATIONAL LAW AND RELATIONS

AUSTRALIA'S SEARCH FOR REGIONAL SECURITY IN SOUTH-EAST ASIA

(L. C. Card No. Mic 59-2345)

Henry Stephen Albinski, Ph.D.
University of Minnesota, 1959

Adviser: Lennox A. Mills

Because she is a small and isolated outpost of Western civilization located on the border of Asia, Australia has always reacted uneasily to commotions in that part of the world. However, the events of the Second World War produced a special and continuing security concern regarding the region of South-East Asia, the logical base of operations for Australia's enemies. A fresh spirit of diplomatic initiative arose, as did the belief that America had replaced Britain as Australia's principal source of protection in the East.

The parallel emergence of newly independent political entities in South-East Asia and of Communist interest in the area has created exceptional difficulties for Australia.

Australia knows of the various successes Communism has gained in Asia within a short period of time, and wishes to prevent its further spread in the region, whether it be Communism imposed by overt force or by subversion and the exploitation of Asia's social, economic, and political grievances.

In an attempt to win military security for herself and for her neighbors, Australia has entered into defensive alliances, has sought the favor of powerful America in such ways as refusing to recognize Red China, has dispatched troops to Malaya, and has steadfastly supported her Dutch friends in New Guinea. As she has observed Communism's tactics of subversion and propaganda, Australia has concluded that military preparation is not in itself a suitable counter-measure against Communism. If Asia is to be insulated against Communism, it has been felt, Australia and the West must strengthen Asia's economies, improve its social services, and make certain that free political institutions will not fall through their own inability to solve internal problems or through subversive pressures. If South-East Asia can thus be preserved from Communism, Australia's own security will be enhanced. If the nations of South and South-East Asia can extend confidence and good will rather than suspicion and hostility toward the West, the general cause of resistance to Communism will be improved, and the West's specific efforts to construct needed military deterrents in the region might be more meaningful. Hence, to promote South-East Asia's stability and to gain its friendship, Australia has sponsored the Colombo Plan, has encouraged diplomatic and other exchanges, has made professions of her high intentions, has attempted to bring free Asia into SEATO, has expressed reluctance to endorse provocative American policies around Formosa, and so on.

But Australia has increasingly found that she cannot accomplish all of her objectives. SEATO's weaknesses and the uncertain future of Malaya and Singapore raise doubts about Australia's intention of maintaining "defense in depth" in South-East Asia. Also, although in her endeavor to act the part of leader and of a bridge between Asia and the West Australia enjoys certain advantages, she finds that at almost every step she must choose between that aspect of security which stresses arms, alliances, and American support on the one hand and Asia's friendship on the other. By seeking re-insurance by one set of measures, she seems in jeopardy of forfeiting the benefit of the other set. Within her own boundaries, the intransigence over admitting Asian migrants is a persistent source of embarrassment when lofty pronouncements about cultivating Asian amity are made.

Within the microcosm of Australia the enormous difficulty of winning Asian friendship if unpopular measures are concomitantly pursued can be perceived. Then too, the increasing inability of Australia to find satisfactory means by which to create military defenses in and for South-East Asia, either in concert with others or alone, suggests the magnitude of such a task for the entire Western coalition.

Microfilm \$6.55; Xerox \$22.80. 516 pages.

A POLITICAL ECONOMIC SURVEY OF SOVIET CENTRAL ASIA

(L. C. Card No. Mic 59-2225)

Albert Edward Burke, Ph.D.
University of Pennsylvania, 1959

Supervisor: Robert Strausz-Hupé

This study analyzes several definitive changes brought about by Czarist and Soviet Russians in the lives of Central Asia's non-Russian peoples, as reflected in land-use practices. The premise of this work is that such changes in the lives of the Uzbek, Kazak, Kirgiz and Tajik peoples can be seen clearly in the way these people have used their lands and resources throughout a selected period of time. The land-use practices of any group of people will reveal many facets of their political, social, economic, religious and philosophical beliefs. From this point of view the general characteristics of the changing local economy of Central Asian peoples is presented.

The scope of this study has been limited to a political-economic survey of agriculture and pastoralism among the above-mentioned peoples. A significant development of industry has taken place in recent years in the five republics which bear their names. Land-use practices now include mining and related resource development usually associated with manufacturing processes the world over.

While the region is treated as a unit, because the five republics display much the same overall environmental and ethno-cultural similarities, special consideration has been accorded two small communities which reflect as wide a range of difference in environment and ways of life as can be found in Central Asia. Whenever possible, Czarist or Soviet Russian sources of information were used. It was necessary to be critically selective in using the more recent Soviet sources. The quantity of materials published by the Soviet government about the region is great, but the quality of most of it is poor. Source materials which were not inconsistent with conditions and developments in the region as analyzed over many years by reputable authorities, have been included.

The greatest degree of change has taken place during the Soviet period, in accordance with the ideas and practice of controlled culture change which are the substance of present day Russia's "Nationalities Policies". According to Soviet theory, a less advanced underdeveloped society, under the controlled supervision of a more advanced, developed society can be raised in status through a series of predetermined steps. These are based on what Soviet theoreticians describe as the "laws of history and social development". However, Soviet claimed success in integrating its Central Asian non-Russian minorities is not the result of a unique system of controlled culture change, but is the result of an overwhelming and powerfully dominant Russian culture supported by a military and police power.

The peoples of Central Asia affected most strongly by Soviet power are those located in the more highly productive parts of the region. Central Asia's importance as a source of industrial and agricultural raw materials was as great after the Bolshevik Revolution in 1917, as it had been earlier under the Czars. The areas which could be exploited to yield the greatest returns were developed first, and to the greatest degree. Whatever differences in

level of development remain, a definite end exists for all Central Asian peoples when present Soviet administered processes of culture change are completed. There remains only a narrowing difference between the economic lives of all Soviet citizens.

Central Asia is an important base for the expansion of Soviet power into non-Soviet lands in middle and far Asia. Growing industrialization and westernization there magnifies the contrast with the relatively unprogressive lives of neighboring, ethnically related peoples. Its place as a propaganda center and show-case of the material accomplishments of communism has been emphasized by Soviet leaders who have described Central Asia as "a spearhead for the penetration of Soviet ideas to the East."

Microfilm \$4.85; Xerox \$16.20. 380 pages.

SIGNIFICANCE OF SOCIAL CONTRACT THEORY FOR INTERNATIONAL ORGANIZATION

(L. C. Card No. Mic 59-2028)

Thomas Andrew Israel, Ph.D.
University of Illinois, 1959

This study of the Significance of Social Contract Theory for International Organization inquires first of all into the relationship of law, sovereignty and human rights within the abstract, ideal state as this relationship is seen by social contract theorists Hobbes, Locke, Rousseau and Kant. While there are differences of emphasis and of position among these philosophers, there is good evidence to support the conclusion that the social contract was not intended to be an historical explanation of how states originated, but rather should be seen as a basis for a commitment on the part of citizens to participate in the life of the civil body which at its best is an order of law promoting the full freedom of public discussion.

This is to say that the social contract as a concept of reason gives support to a republican constitutional system, one in which the rulers heed the decisions of the public. According to this theory in its mature form, man must exercise responsible freedom under the institutions of the civil body or accept the slavery of despotism or the chaotic and insecure existence of the state of nature.

However, nations in their relations with one another are in a state of nature or a state of war. In fact under the theory of the balance of power each nation, acting in terms of its "vital interests", must build up an advantage over its rivals, with the result that the process of military expansion and international tension of the state of nature would never end.

But this anarchic condition of nations only disrupts their efforts to achieve republican constitutions internally, for now they must place a premium on secrecy and dispatch, granting exceptional power to their governments which in turn must spend their energies and funds on military buildups for "defense" against "aggressions" by foreign powers.

From this analysis it follows that the harmonious relationship of law, sovereignty and human rights within states under social contract theory, calls for an international order of peace among states. In the thinking of Rousseau and Kant such an order would finally become a

World Union of states. Although there can be no indisputable assurance that such a Union is possible, man's obligation as a rational being, according to Kant, is to work for its approximation.

The Constitution of the United States is perhaps the closest actual approach to a contract of states as envisaged by Rousseau and Kant; and while a comparison of conditions leading to the establishment of the Constitution of the United States with conditions among the nations of the world today shows both differences and similarities, the experience of the ratification of the Constitution of the United States indicates that the establishment of a Federation does not depend on common agreement on questions of human rights.

However, one of the most serious obstacles to peace today, as well as to international understanding in the sense of co-operation in action, is the emergence of international "propaganda warfare", the "success" of which would make genuine communication among nations impossible. Nations as bodies of responsible citizens working for a closer approximation of peace under republican constitutions must cherish the freedom of communication.

Also they must extend higher living standards to more people through an expansion of world trade, and they must promote international security through the acceptance of workable disarmament programs. As difficult as it is to accomplish such objectives under conditions of cold war, the prospects are not hopeless. For now more than ever before, man's duty to work for peace is supplemented by his interest in survival.

Microfilm \$2.20; Xerox \$7.60. 165 pages.

THE JAPANESE PEACE TREATY AND ITS IMPLICATIONS FOR JAPAN'S POST-WAR FOREIGN POLICY

(L. C. Card No. Mic 59-945)

Eiichi Okajima, Ph.D.
New York University, 1956

Adviser: Professor Charles Hodges

The San Francisco Peace Treaty with Japan was an inevitable result of the American-Russian antagonism and the conflicting demands of Allied Powers after World War II. The war that broke out in Korea in June 1950 made the United States realize anew Japan's strategic and political importance in the struggle against international Communism. The Japan-U.S. Security Pact, which constituted an important part of the general peace settlement, was essential to the successful conclusion of the military operations in Korea.

Washington intended to incorporate the security arrangement for Japan into a more general all-embracing anti-Communist Asian pact. The deliberate omission of a provision in the Peace Treaty forbidding Japan's possession of armed forces, together with the United States efforts to gradually increase Japan's defensive buildup, inescapably created a constitutional problem in Japan. The Japanese voters dislike the idea of rearmament, be it legal or illegal. Any political party openly favoring immediate rearmament and the constitutional changes

necessary for that purpose seems to be certain to lose popular support. The demilitarization policy of the Occupation, rather than the Treaty, is to blame for producing political instability in this respect. The present trend is toward establishing armed forces by calling them national security forces and giving a more liberal interpretation to the war-renunciation clause of the Constitution.

Japanese irredentist sentiments for their former territories, which the Treaty took away, are growing stronger. Their economic significance was great. The Kuriles and South Sakhalin were not given to Russia by the Treaty, but remain occupied by its troops. The Soviets will have to retrocede some of these territories to Japan, if the peace negotiations are to make any semblance of success. The United States also will find it necessary to retrocede the Ryukyus to Japan, when the Japanese have assumed full responsibility for their security.

Criminal jurisdiction over the foreign forces in Japan was another problem that the Treaty presented to Japan. It was solved according to the principle of international law, thus strengthening the law of nations. Korea, a country reborn under the Peace Treaty, claims as its territorial waters what international law has long recognized as part of the high seas to exclude Japanese fishing operations. Australia also adhered to the theory of the "continental shelf" being part of its territory to exclude Japanese pearling operations. The latter case has been brought to the International Court of Justice. The decision will constitute an important precedent in the law of nations.

A problem left unsolved by the Treaty was Japan's reparations for South-East Asian countries. The negotiations have been carried out without great success, with the exception of Burma. Restoration of the South-East Asian market is essential to Japan's economic recovery, particularly when the Communist China market has been closed. Although the Treaty allowed Japan to trade with foreign countries without hindrance, Japan is bound by the Battle Act and the Foreign Asset Control Act of the United States. Restrictions on trade with Communist China will have to be modified to permit commerce up to the same level of that of West European nations. This is essential as Japan is suffering from economic instability due to an imbalance of its international payments, loss of colonial possessions and discriminatory tariff treatment from foreign countries.

As a whole, the Japanese Peace Treaty was a result of the existing conflict between America and Russia. The absence of China and Russia, though inevitable, left post-war Japan in a more complicated position than otherwise. The Treaty has nevertheless resulted in the establishment of the foundation for a durable friendship and cooperation between the United States and Japan.

Microfilm \$8.25; Xerox \$28.20. 651 pages.

GANDHIAN ELEMENTS IN INDIA'S INTERNATIONAL RELATIONS

(L. C. Card No. Mic 59-2264)

Indira Nalin Rothermund, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. N. D. Palmer

The Gandhian elements discussed in this thesis are:

- 1.) a concept of truth as a dynamic force
- 2.) an emphasis on means rather than ends
- 3.) a belief in the power of restraint
- 4.) a tendency to see personal, national, and international relations as a series of concentric circles of good neighbours
- 5.) an insistence on individual independence and self-determination, and a disregard for the problem of territorial sovereignty
- 6.) an identification with underprivileged peoples
- 7.) anti-communalism stemming from an attack on particularist tendencies in Indian society
- 8.) a pattern of thought which is characterized by a proceeding from the general to the particular, and beyond the particular to a higher generality.

These eight points are not isolated; they are aspects of the basic Indian philosophy of the "identity of all life", i.e., the identity of the soul with God. This philosophy implies that reality, truth, and the good are only aspects of one and the same thing, a concept which is also evident in Indian languages: the term 'sat' meaning 'being', the term 'satya' - derived from 'sat' - meaning 'truth'. Right action is seen in conforming to truth, an idea which Mahatma Gandhi expressed in the term 'satyagraha' meaning 'holding fast to truth'. The same thought can be found in the motto of the Indian Republic: "Satyam eva jayate" meaning "Truth alone triumphs".

The often criticized "tone of moral superiority" of Indian politicians will be understood better if we can keep the implications of this philosophy constantly in mind. It is a philosophy which insists that ethical international relations are the only means to achieve true knowledge of the nature of reality in world affairs; "bad", -that is, hostile - international relations, on the other hand, blur the vision.

Gandhi spoke in religious terms, modern Indian leaders like Nehru try to express the same attitudes in psychological terms, and speak of the "climate of war" or the "cold war mentality".

An analysis of Gandhi's slogans and campaigns, and of his impact on the Indian national movement seems one of the best ways to get a clear picture of this philosophy at work. In this way it is also possible to point out the quite unintended results of some of Gandhi's actions, many of which were of great consequence to independent India's foreign affairs. The method of this thesis is, therefore, a combination of philosophical, behavioral, and historical analysis. The thesis contains chapters on:

- 1.) the historical situation at the time when Gandhi

assumed national leadership 2.) Gandhi's political terms and symbols with which he conveyed his ideas to the Indian masses 3.) the relationship between Gandhi's concept of truth and right action and the tradition of Indian philosophy 4.) the development of Gandhi's practice of restraint and the influence of this practice on the Indian national movement and its leaders 5.) Gandhi's identification with the underprivileged, and the current Indian identifications with subject and underprivileged peoples 6.) the partition of India resulting from an adverse reaction on the part of Muslim politicians to Gandhi's attempts at Hindu-Muslim unity, and the meaning of Indo-Pakistan relations 7.) a comparison of the "reflective" Indian attitude toward international relations with the "normative" American attitude and the "partisan" Soviet-Russian attitude.

It is hoped that this study will give the analyst of India's behavior in world politics some insight into the working of the Indian mind, and some knowledge of the ideas that influence the Indian outlook on international affairs.

Microfilm \$3.30; Xerox \$11.20. 255 pages.

**THE TRUSTEESHIP COUNCIL OF THE
UNITED NATIONS AND SELF-GOVERNMENT,
WITH PARTICULAR REFERENCE TO
BRITISH EAST AFRICA, 1947-1951.**

(L. C. Card No. Mic 59-2271)

Will Joseph Selzer, Ph.D.
University of Pennsylvania, 1959

Supervisor: Dr. Philip E. Jacob

This study is concerned primarily with an evaluation of the impact of the Trusteeship Council of the United Nations on the development of self-government in the trust territory of Tanganyika and the two adjacent non-self-governing territories of Kenya and Uganda during the period 1947-1951.

According to available United Nations data, a non-self-governing territory attains self-government when its government fully reflects the consent of the governed, said consent being given in an election or referendum predicated upon the principles of universal adult suffrage and majority rule. In addition, when the time has arrived for the territory to choose its status in the international community, the option of independence must be available. Since Africans comprise over 95 per cent of the population of each territory, primary emphasis was given to increased African participation in the governmental operations of each dependency.

The developments toward self-government in the three dependencies left the African population a considerable distance from the day when they will be capable of realizing that goal. No Africans were elected to the Legislative Council during the period under review, and nomination by the Governor, even where an informal indirect electoral system was utilized, left much to be desired regarding the independent representative function that a government based on the consent of the governed requires. Native Authorities and councils responsible for the bulk

of the African population in each territory were still under the control of the Governor and his agents, the Provincial and District Commissioners. Without a formal electoral system utilizing a secret ballot at any level of government, the actual participation of the African population in the governmental process is difficult to assess. The absence of a free independent electoral system made the development of African political parties exceedingly difficult. In the realm of administration, the record reveals only 1 African was capable of employment at the top level, and not much more than that number participated in the judicial process of the three territories. In addition, there is some evidence to indicate that racial discrimination was practiced in the personnel policy of the three dependencies under investigation.

The impact of the Trusteeship Council upon British administration was noted in two major instances. The most important was the acceleration of the development of a conciliar system in native administration in Tanganyika after the Trusteeship Council had criticized the Administering Authority's policy of indirect rule. The second was the contribution of the Trusteeship Council in the development of a moderate racial outlook in Tanganyika which permitted the Constitutional Development Committee to make a unanimous recommendation of racial parity for the Legislative Council which was subsequently accepted by the United Kingdom government. There was no impact of the Trusteeship Council to be noted vis-a-vis British administration of Kenya and Uganda. The Trusteeship Council's shortcomings were also discussed, including its dependence upon the cooperation of the Administering Authority in Tanganyika; United Kingdom criticism of the qualifications of the representatives of the Non-Administering powers on the Council; the behavior of the representative of the Soviet Union; the cleavage-ridden atmosphere on the Council generated by the Cold War and the liquidation of colonial empires; supervision after the fact; a reluctance of the Council to interpret conclusions of its Visiting Missions to Tanganyika; the balanced membership requirement of the Charter; and the Council's failure to stay on top of political developments in Tanganyika and in East Africa concerning Tanganyika's future political status. Microfilm \$3.60; Xerox \$12.20. 277 pages.

**POLITICAL SCIENCE, PUBLIC
ADMINISTRATION**

**A STUDY OF PROBLEMS IN THE
CONTROL OF DEPRECIATION BASIS
BY THE GOVERNMENT**

(L. C. Card No. Mic 59-1835)

Fazlollah Akbari, D.P.A.
University of Southern California, 1959

Chairman: Professor W. B. Storm

Most business organizations have large amounts of investment in capital assets. The determination of profits from operations requires that the amount of capital assets

which has been consumed during a period be charged against the revenue earned during the same period. The ascertainment, however, of the amount of this charge, known as the depreciation for the year, is not an easy process. Factors of time, deterioration, usage, obsolescence, and technological developments affect the real value of capital assets; and the amount of the depreciation for the year depends upon this value—an ever-changing basis.

Inapplicability of the scientific precision in depreciation accounting has caused the favoring of other bases therefor and has created a point of difference between the government and business. Government interest in the subject stems from the fact that the depreciation for the year is a tax-deductible item from business revenue and that the amount of taxable income depends thereon.

The present basis of original-cost accounting for depreciation has created problems for the replacement of capital assets, for the accurate presentation of financial statements, and for national income accounting. It has also proved to have a penalizing effect on heavy industries.

The study has been made for the purpose of analyzing the alternatives available for use as the depreciation basis with a view to developing a solution for the problems.

In the conduct of this study, important publications on the subject in the Library of Congress, New York Public Library, and many other university and public libraries were reviewed. Los Angeles Deputy District Director of Internal Revenue and a number of authorities on the subject at the national meeting of the American Accounting Association were interviewed.

Findings. The study indicated the availability of three alternative bases for depreciation accounting: (1) the original-cost basis, (2) a general-index-adjusted value, and (3) present value determined by appraisal.

The last two bases, however, are found by the study to be unacceptable for tax purposes. Depreciation accounting involves the computation of three factors: service life, salvage value, and the value of the asset. The first two are pure estimates. The last two alternatives will make the third factor also an estimate. Thus, the last two methods will cause the depreciation accounting to be too subjective to permit the auditing of tax returns. To this difficulty the unavailability of a capital asset index, advocated for the second method, is to be added. Therefore, the only alternative left in this group of alternatives is the original-cost basis.

Recommendations. It is proposed that an imputed-interest approach based on the economic theory of opportunity cost will eliminate the present problems of depreciation accounting to a great extent. This approach requires that interest at the prevailing rate be imputed to the unrecovered balance of investment in a depreciable asset. The result obtained will be added to the portion of the historical cost assigned to the accounting period. The total thus acquired constitutes the depreciation for the year. The imputed-interest amount, however, is also used for the adjustment of the value of the asset.

Conclusions. The proposed method will provide a better basis for the presentation of financial data, for the replacement of capital assets, and for the taxation of business income. It will make possible the administration of government income taxes with increased fairness and accuracy. In the meantime, it will establish a criterion for distinguishing organizational efficiency and managerial skills through the separation of earnings of capital from those of managerial activities. Microfilm \$2.60; Xerox \$9.00. 200 pages.

AN ANALYSIS OF PERFORMANCE BUDGETING IN THE CITY OF LOS ANGELES

(L. C. Card No. Mic 59-1842)

Ali M. Eghtedari, D.P.A.
University of Southern California, 1959

Chairman: Professor Frank P. Sherwood

This dissertation described and analyzed performance budgeting in the City of Los Angeles. Justification for the conduct of the study was the lack of any detailed empirical study of performance budgeting in a municipal government. The present writings on the subject do not go beyond a theoretical and abstract discussion of performance budgeting.

This study was limited to budget preparation, review, and adoption in the City of Los Angeles. Its basic limitation is that it does not cover budget administration and control. For an analysis of departmental budget preparation, the study examined the Department of Building and Safety and the Department of Public Library.

In the conduct of this study, many members of the City Administrative Officer's staff, a number of personnel in the departments concerned, and all members of the City Council were interviewed; the Council's 1958-59 budget hearings were attended; many records, reports, and work programs were examined; and extensive use was made of the literature on the theory and practice of governmental budgeting.

Findings. 1. Performance budgeting in the City of Los Angeles has been used as a valuable tool for program planning at the departmental level. It has also provided for a basis for management control. However, it has not contributed significantly to improved legislative decision making in the appropriations process. In actual practice, performance budgeting has reduced the role of the Council in making budgetary decisions, and it has increased the executive power over the City's purse strings. The Council has come to rely heavily on the budget recommendations of the City Administrative Officer because the Council tends to regard him more as its man than as the Mayor's staff assistant and because of time and technical limitations for an independent analysis of the budget.

2. About 85 per cent of personnel in the Department of Building and Safety and the Department of Public Library were engaged in activities for which units of measurement have been selected. The validity of these work units on the basis of consistency over a three-year period was examined. It was found that, except for several work units, they did not show such unreasonable variations as to invalidate their accuracy. However, the difficulty involved in measuring the results of performance and also in setting up standards based upon a measurement of quality of service rendered was found to have caused a considerable concern in the Public Library, whose educational and social objectives are less susceptible to tangible measurement than the activities of the Department of Building and Safety.

3. A comparison of the actual work load with the estimated work load for a three-year period in the departments concerned revealed that for the most part the actual work load did not show drastic deviations from the estimated work load. However, the man-hour per work unit standard of performance is determined subjectively and frequently on the basis of previous year's experience.

It was further found that performance effectiveness has been declining in the Department of Building and Safety and has been increasing in the Public Library.

Conclusion. Despite certain shortcomings of the system, performance budgeting in the City of Los Angeles is well established. Significant improvements have been made in many areas, while certain aspects of performance budgeting in this jurisdiction need further improvement through management research and legislation. In general, performance budgeting in Los Angeles has improved program planning, but its actual value in improving the legislative phase of budget making is doubtful.

Microfilm \$3.55; Xerox \$12.00. 275 pages.

**CITY MANAGER-HOSPITAL ADMINISTRATOR
RELATIONSHIPS: A STUDY IN
ORGANIZATIONAL MORPHOLOGY**

(L. C. Card No. Mic 59-1859)

Evangelos John Rizos, D.P.A.
University of Southern California, 1959

Chairman: Professor Sherwood

This dissertation was primarily concerned with departmental structure. Organization has been viewed as a means of achieving social objectives, not as a goal or as a value in itself. The theme of the dissertation is relatively old, yet the problems posed are modern. As long as the feeling persists that the relative values of alternative organizational schemes are not easily ascertained, their character will continue to hold lasting and universal interest.

As an area of concentration, the organizational and functional relationships of the municipal hospital, representing a part, to the city manager, expressing the whole, have been selected. In some cities, the municipal hospital forms an integral part of the administrative organization of the municipal government. In others, it has an autonomous existence under an independent board.

In the conduct of this study, publications of the International City Manager's Association and the American Hospital Association were consulted, and municipal ordinances were analyzed. An exploratory survey of seventy-seven council-manager cities was conducted; forty-eight replies were received. Interviews and correspondence with city managers and hospital administrators of municipal hospitals supplemented the data-gathering process.

Findings. No pure form of administrative independence was found, the "board hospitals" tending in general to preserve a certain autonomy which at best could be characterized as a limited one. The picture of two contesting schools of thought has caused no heated arguments—rather, in the subtlety of their presentation, city managers and hospital administrators have displayed a disposition to compromise, particularly in the creation of hospital advisory boards. Such boards, while permitting a necessary degree of integration, bring the community closer to the operating problems of the hospital, assure planning in execution of services needed by the community, and function to disperse the fear and disadvantages that are usually associated with concentration of authority.

No simple criteria by which to evaluate the various organizational forms were isolated. Three indices were examined and it was discovered that the lowest cost per patient and higher utilization of personnel rather substantially correlated with hospitals functioning under direct responsibility to the city manager.

Conclusions. It appears that certain functions of the city government pose special kinds of problems which deserve organizational expression. While structure does not answer all these needs, this study suggests its significance. A board, composed of laymen and without specific powers, appears to be an appropriate compromise between the needs of the hospital for independence and flexibility, and of the top municipal leadership for cohesion and direction.

Microfilm \$2.45; Xerox \$8.40. 185 pages.

**FIELD ADMINISTRATION IN THE TEXAS STATE
DEPARTMENT OF PUBLIC WELFARE**

(L. C. Card No. Mic 59-2509)

Yadollah Toussi, Ph.D.
The University of Texas, 1958

Supervisor: Dr. Emmette S. Redford

Based on a series of interviews and examination of office documents, this study analyzes field administration in the Texas State Department of Public Welfare.

First, it analyzes field functions. The department determines eligibility and makes assistance grants to needy aged, needy blind, dependent children, and disabled persons. It renders protective services, adoption services and foster care to children, helps unmarried mothers, and cooperates with parents and state district courts to help behavior problem children. It licenses child-caring and child-placing facilities. It distributes federally-granted commodities among needy persons and handles old age and survivors' insurance for state and local employees.

A summary of headquarters organization is followed by a full analysis of field organization, emphasizing that each division or divisional section has its own organization chart, field boundaries, and headquarters offices and that the department is a federation of several divisions. A discussion of *de facto* organization contrasting the official organization chart and the actual system of control follows.

The study analyzes the methods of field alignment which are based on equal distribution of workload among workers in the Public Assistance Division and on grouping of counties having child welfare units in the Child Welfare Division. Then elements that affect choice of headquarters cities and arguments for and against integration of the two divisions are presented.

Field communication comes next. Its purpose is to establish two-way exchange of information routed through unilevel, multilevel, or parallel channels. Some inevitable bottlenecks exist in the agency. Nature of exchanged information differs according to its vertical or horizontal direction. While discussing written media of communication which include manuals, general correspondence and reports, and oral media which include conferences and field trips, orientation and in-service training have been emphasized as effective media.

The goals of field supervision and control are performance according to agency objectives and uniformity of operation. These are achieved by application of methods of supervision and control. They include conferences held at all levels, administrative review methods, evaluation of achievements, personnel actions, and central planning of program operations. The lines of supervision are stratified in the Public Assistance Division but flexible in the Child Welfare Division. Some by-passing occurs in both divisions. Factors that prevent proper control are vagueness of objectives, human elements, heavy caseloads, gaps between theory and practice, and headquarters-field conflict.

Localities may cooperate or resist the agency. Cooperation may be financial or nonfinancial, voluntary or contractual, initiated by the agency or by the locality. Reasons for cooperation are community spirit and transfer

of relief burden to the state. Several methods are used to attract local cooperation. Local resistance, exercised by local officials or interest groups, may be caused by socioeconomic elements, patterns of thought, misunderstanding of programs, or local budget restrictions.

The conclusion emphasized the agency's flexibility of operation, decentralization of field operations due to the nature of welfare programs, coordination through communication and central control, and problems of growth and of recruitment of professionally-trained personnel. Local administration in Texas and Iran are compared with argument that centralization of Iranian administration creates local indifference to public affairs. It may be remedied by decentralization of administration in Iran and infusion of a spirit of provincialism and localism in local man. Microfilm \$3.45; Xerox \$11.80. 268 pages.

PSYCHOLOGY

PSYCHOLOGY, GENERAL

COGNITIVE STRUCTURE AND DOGMATISM

(L. C. Card No. Mic 59-1975)

Eli Alson, Ph.D.

The University of Buffalo, 1959

The present study investigated Rokeach's theory of dogmatic thought using Rokeach's Dogmatism scale and measures of cognitive structure. Rokeach's theory postulates a single dimension of the thought process, labeled "dogmatism" at its extreme pole. Rokeach states that this dimension is composed of interrelated structural properties of belief-disbelief systems, and these structural properties are set up as the variables of open-minded to closed-minded thought. To investigate this theory, Zajonc's measures of cognitive structure were adapted to provide appropriate operational indices of the structural properties of the dogmatism dimension.

The general hypotheses of the present study were (a) that the interrelationships between the cognitive structure measures are high and therefore congruent with Rokeach's assumptions about a single open-to-closed dimension of belief-disbelief systems, and (b) that scores on the Rokeach Dogmatism scale, supposedly measuring this single dimension, are related to the cognitive structure measures used in this study.

A random sample of Veterans Administration Center domiciliary residents at Bath, N. Y. was screened for reading comprehension and for ability to follow instructions. The final sample, 80 domiciled veterans, including 40 Catholics and 40 Protestants, was administered the Rokeach-Dogmatism scale, and interviewed concerning knowledge, beliefs, and disbeliefs about religion, which was the topic chosen for inquiring into the structural properties of dogmatic thought. In the interview, a systematic inquiry was made into the S's cognizance of interrelationships among the various aspects of his religious beliefs and disbeliefs. From the data obtained, six cognitive

structure measures were computed for each S. In addition, the Gardiner Theism scale, the Shipley-Hartford Vocabulary scale, and a specially devised measure of acquiescence response set, were administered for control purposes.

Of the cognitive structure measures reflecting Rokeach's variables, three are constructed so that high scores indicate dogmatic or closed structuring, and hence they are conceived as being positively related to each other. These measures are predominance of beliefs, segmentation, and centrality of the most central belief. The remaining measures, unity of beliefs, unity of disbeliefs, and peripheral unity, are constructed so that high scores indicate non-dogmatic or open cognitive structuring, and hence they are conceived as being positively related to each other. The relationships between the measures of the first group and those of the second are conceived to be negative since the measures relate to dogmatism in opposite directions.

The outcome of the hypotheses regarding the correlations of the cognitive structure measures provided limited support for Rokeach's theory. While not all of the correlations were significant, those which were significant supported the hypotheses except for those involving centrality.

When the Catholic and Protestant subsamples were inspected separately, the magnitudes of correlations in the Catholic group were greater than those in the Protestant group, and more hypotheses were confirmed in the Catholic group. Possibly, the Catholic Ss had more well defined ideas on religion, and therefore were more capable of performing on the cognitive task.

Evidence was reported supporting the validity of the centrality measure, whose relationships with other cognitive measures were in the opposite direction from the theoretical ones. A need for revision of Rokeach's theory with respect to centrality was suggested.

Correlations between the Dogmatism scale and the various cognitive structure measures utilized to test the second general hypothesis were close to zero. Partialling

out possible effects of intelligence, theism, and acquiescent response set did not increase the correlations. The conclusion was drawn that the Dogmatism scale is probably not a valid measure of open-to-closed cognitive organization for the population of this study. Acquiescent response set, which correlated with Dogmatism scores, was suggested as a possible source of error.

Implications of the study were discussed and suggestions for further research were outlined.

Microfilm \$2.00; Xerox \$6.20. 130 pages.

THE SYNCHRONIZATION OF SYMBOLIC FUNCTIONING IN NORMALS, PARANOID SCHIZOPHRENICS AND PARETICS

(L. C. Card No. Mic 59-2339)

Donald Horton Armsby, Ph.D.
Temple University, 1959

The purpose of the present investigation was to propose a theoretical framework for the analysis of symbolic functioning and to compare the synchronization of symbolic systems in normals, schizophrenics and organics. We are concerned with two symbolic systems: the analogic and the digital. The analogic symbolic system constitutes a series of symbols that in their proportions and relations are similar to the referent for which they stand. Digital symbols have an arbitrary relationship between the symbol and referent, are necessary for the formation of abstractions and constitute the major portion of our society's verbal language structure.

There are three basic concepts in the theoretical proposal.

The first concept is that both of these symbolic systems have inherent strengths and weaknesses and that there is no reason to assume that either system is a more advanced or more adequate view of reality than the other.

The second basic concept is that for effective communication there must be some degree of synchronization between these two systems.

The third basic concept is that in the event of psychopathology there is a differential effect upon the two systems in such a way that the digital system is affected more severely than the analogic system. It was this third concept that was directly examined in this investigation.

In order that symbols can be used for effective communication they must result in consensual validation. Three dimensions of consensual validity were utilized in this investigation: conventionality (intergroup agreement) - the degree to which the choice of symbols corresponds to the normal choice, consensuality (intragroup agreement) - the degree to which the choice of symbols of each subject corresponds to the group median choice of the group to which he belongs, and stability (intraindividual agreement) - the degree of consistency with which each subject uses symbols.

The subjects consisted of 20 normals, 20 paranoid schizophrenics and 20 paretics individually matched on sex (all males), age, education and marital status. The psychotic subjects were all chronic cases and were individually matched on the length of hospitalization. Since part of the test material is colors, all subjects were

tested and found not to be color-blind. At the time of testing all the subjects were given the vocabulary subtest of the Wechsler Adult Intelligence Scale. The variance due to intelligence was removed from the comparison of the scores on investigation by the use of the analysis of covariance.

Three test conditions were used and for each condition there were two variable aspects: the nature of the analogic symbol and whether the task was to focus upon the digital or the analogic symbol. The purpose of the conditions was to synchronize digital and analogic symbols. All the digital symbols were in the form of words with strong affective connotations. In Conditions #1 and #2 the analogic symbols were non-representational lines and in Condition #3 were colors. In Condition #1 the focus was upon the analogic symbols and in Conditions #2 and #3 the focus was upon the digital symbols.

In Condition #1 there were no differences between the groups on conventionality, consensuality and stability of symbolic synchronization. In Condition #2 there were significant differences between normals and psychotics on conventionality, consensuality and stability. There were also significant differences between organics and schizophrenics on conventionality and stability but not on consensuality. In Condition #3 there were significant differences between normals and psychotics and between schizophrenics and organics on conventionality, consensuality and stability.

The results support the hypotheses that there are two symbolic systems and that the analogic symbolic system is more resistant to the effects of psychopathology than is the digital symbolic system.

Microfilm \$2.00; Xerox \$5.00. 100 pages.

SOME FACTORS INFLUENCING THE ACQUISITION AND UTILIZATION OF CUES

(L. C. Card No. Mic 59-1977)

Loy S. Braley, Ph.D.
The University of Buffalo, 1959

The purpose of this study was to determine some of the conditions controlling the range of initially incidental cues that human subjects will acquire and utilize during a continuous process of discrimination learning and how this may relate to a response-inferred motivational variable. This is a specific case of a more general area concerned with the variables determining the "breadth of learning."

The experimental procedure required the selection of two groups of forty subjects, each defined by an extreme score on the Taylor Manifest Anxiety Scale with appropriate controls for intelligence and/or learning rate. Through two adjacent windows in a plywood screen these subjects were exposed to a series of cards containing combinations of colors and geometrical forms and were required to choose the correct one of these from the two cards simultaneously presented. First a simple color-form discrimination was learned to criterion in a Training Series (Phase I). Phase II was continuous with Phase I so that after meeting criterion half of the subjects (experimental or Cue Exposure Group) were exposed to a series

of ten trials where the primary cue was still present and reinforced as correct but with the additional presence of two new secondary cues. The secondary cues appeared in spatial conjunction and were reinforced with the primary cue. In place of the Cue Exposure series the control subjects were simply continued for an equivalent number of trials beyond criterion with only the primary cue present. Continuous with Phase II was the Test Series or Phase III. Here a correct discrimination could only be made on the basis of the two secondary cues. There were actually two different series comprising Phase III. In one (Primary Cue Continuation Series) the primary positive cue was continued on one half of the trials though it was now negative, while in the other (Primary Cue Absent) the primary positive cue was entirely absent.

A synthesis of several experimental studies and theoretical formulations led to three main hypotheses:

- (a) The introduction of non-signal (secondary) cues after an initial discrimination had been formed and subjects were in a post-criterion performance phase, would facilitate learning a subsequent discrimination when the secondary cues became signal, or formed the basis for correct discriminations, as compared with a control group not previously exposed to such secondary cues.
- (b) Subjects scoring high on a motivational variable would make less efficient utilization of the non-signal cues as reflected in a subsequent discrimination when those cues became signal and were the basis for correct discrimination.
- (c) The continuation of a previously positive cue into a new discrimination situation where its reinforcement value was now negative would have differentially facilitating or hindering effects as a function of low or high motive strength respectively.

The experimental design and primary analysis of results was in the form of a 2x2x2 analysis of variance. Results of the major predictions were:

1. Subjects did indeed learn something during Phase II when non-signal (secondary) cues were present but the effect was to impair rather than facilitate subsequent discrimination learning when the secondary cues formed the basis for correct discrimination. In an attempt to understand the reversal of this prediction two other factors were conjectured; one associated with stimulus competition between the primary and secondary cues, and the other having to do with a process of inhibition of attention to the secondary cues.
2. The prediction that high scorers on the motivational variable would show significantly poorer performance on the final discrimination task than would low scorers was not confirmed. No significant difference between these groups was found.
3. Only partial confirmation of the third hypothesis was obtained. Continuation of a previously positive cue into a new discrimination situation where its reinforcement value became negative had a facilitating effect irrespective of high or low motive strength.

Several other dimensions of the experiment were analyzed to further explicate the results obtained. A number of aspects emerged that suggested further research on the manner in which the character of the stimulating events and the way in which they are programmed to the sub-

ject influences the amount and nature of the information acquired. Microfilm \$2.00; Xerox \$4.40. 85 pages.

COGNITIVE RIGIDITY AS A BEHAVIORAL VARIABLE MANIFESTED IN INTELLECTUAL AND PERCEPTUAL TASKS BY AN OUTPATIENT POPULATION

(L. C. Card No. Mic 59-2441)

Gerd H. Fenchel, Ph.D.
New York University, 1959

Adviser: Dr. I. Chein

This study is primarily concerned with specifying task conditions that will elicit a consistent rigidity phenomenon. Rigidity is defined as failure to adapt oneself to changes in task conditions when the situation clearly demands it. It is specifically hypothesized that only those cognitive tests that force an active restructuring of cognitive patterns can elicit rigidity. Tasks that allow for only one goal path to lead to successful adaptation have been defined as forced-dichotomous choice situations. The tests selected for this investigation as conforming to the criterion are the water-jar Einstellung problems and the Gottschaldt figures. Previously used instruments to test for rigidity, a verbal similarities test and a motor perseveration task, which provide more than one goal path to achieve success are included in this study for the sake of contrast. The water-jar Einstellung task has been employed as a criterion test for cognitive rigidity.

A further purpose of this investigation is the extension of the concept of 'rigidity' to general life situations and more general personality concepts, such as Ego-strength. To measure rigidity in life situations, an attitude scale concerned with 'rule-riddenness' is administered. Ego-strength is measured by an MMPI scale developed by Barron. In order to test the initial assumptions of the study, four hypotheses are offered:

1. The water-jar Einstellung problems and the Gottschaldt figures, both conforming to the criterion for rigidity eliciting tasks, will show consistent behavior.
2. Previously used rigidity measures not conforming to the task criterion, the verbal similarities test and the motor perseveration task, will exhibit little or no consistency with the Einstellung problems.
3. Cognitively rigid individuals will exhibit rigid attitudes as reflected in marked 'rule-riddenness.'
4. Cognitively rigid individuals have relatively low Ego-strength as measured by the Barron scale.

The subjects of the study are sixty-three persons applying for outpatient treatment at a mental hygiene clinic. They had to fulfil the following prerequisites to be selected: (1) normal intelligence, (2) no indications of organic brain damage, (3) absence of acute psychotic symptoms. The test battery was administered routinely as part of the screening process.

Test results were intercorrelated with intelligence, as control variable, partialled out. A further analysis of dichotomies was undertaken (rigids versus non-rigids) by means of t-tests and Chi-Square. The findings, low but significant correlations, are interpreted in support of the

first three hypotheses. The implications are that rigidity can be measured consistently only in defined circumstances, a necessary condition being the forced-dichotomous-choice nature of the goal path. Rigidity elicited under such conditions is not an experimental artifact unrelated to life but is shown to bear relation to social attitudes, such as rule-riddenness. The hypothesized relationship between rigidity and Ego-strength is not borne out and needs further exploration. Microfilm \$2.00; Xerox \$4.40. 81 pages.

**A STUDY OF THE RELATIONSHIP BETWEEN
CERTAIN FACTOR-ANALYZED ABILITY MEASURES
AND SUCCESS IN COLLEGE ENGINEERING**

(L. C. Card No. Mic 59-1844)

Glenn Arthur Foy, Ph.D.

University of Southern California, 1959

Chairman: Professor Floyd L. Ruch

The shortage of trained engineers in the United States has become critical. To have more engineers, it is necessary that the training facilities in this country be used more efficiently by selecting the more promising students and thus cutting down on the high attrition which occurs among engineering students. At the present time the best selection devices in use have validity coefficients in the vicinity of .60. These are usually very significant validity coefficients statistically, but they still are not high enough practically as shown by the low survival rate that still occurs; i.e., only about one third of those entering engineering as freshmen ever graduate in engineering.

A new and unusual approach to the problem of prediction and selection has been provided by the Employee Aptitude Survey. It is a battery of ten unique tests varying in length from five to ten minutes of testing time and designed to result in maximum validity per minute of testing time. The battery has been factor-analyzed and the primary abilities determined. This has resulted in a battery of tests measuring independent and specific abilities that are related to engineering. Another major factor of the EAS is that it was developed for predicting on-the-job performance of employed graduate engineers and has proved valid for such prediction.

It was the primary purpose of this study to determine whether or not the known psychological factors of the EAS are related to successful completion of the first two semesters of the engineering curriculum and, if they are related, to what extent they are related. A secondary objective was to explore the relationships between the various predictors and the criterion in an attempt to predict the criterion and to achieve the maximum relationship between the predictors and the criterion using various combinations of methods.

The experimental procedure was designed to facilitate the double cross-validation techniques and at the same time to test the major and secondary hypotheses. The EAS was administered to the entire freshman engineering classes for two successive years at the University of Southern California. The criterion was based upon a "pass-fail" dichotomy after two semesters for each group. Predictor-criterion correlations were computed for the

predictor variables and for the Scholastic Aptitude Test. Since all the validity coefficients of the predictors were very significant, they were used in computing multiple correlation coefficients by the Doolittle method and a double cross-validation procedure was applied to the results. The same procedure was applied to various combinations of the predictors, and a shortened battery of five of the EAS tests were found to produce multiple R's that were not significantly different from that for the entire battery. To increase the predictive efficiency, a multiple-cutoff method was applied to the battery in addition to the multiple correlation techniques.

On the basis of this study, it was concluded that engineering aptitude is composed of a combination of aptitudes of primary abilities and that the single factor most highly related to success in the first year of the engineering curriculum is numerical ability. From double cross-validation results, the EAS has proved to be a superior instrument for predicting success in the first year of college engineering; the multiple R's obtained from two independent samples were superior to any validity coefficients found in the literature. Interpreting the results from the multiple cutoff method, it was concluded that there is a lower limit to each primary ability below which the generalization phenomenon is no longer valid. In comparing the results from the EAS with those from the SAT, the evidence indicates the Survey is a superior predicting device to the SAT. However, much work remains to be done before final decisions are made relating test scores to various curricula and institutions, and to various criteria of success. Microfilm \$2.00; Xerox \$5.00. 99 pages.

**THE RELATIONSHIP BETWEEN CLASSIFICATION
KEYS AND PREDICTOR KEYS IN
INTEREST MEASUREMENT**

(L. C. Card No. Mic 59-2352)

Somnath Ghei, Ph.D.

University of Minnesota, 1959

Adviser: Kenneth E. Clark

Interest measures have a high degree of concurrent validity but their status in terms of predictive validity is yet uncertain. This study was designed to investigate the relationship between classification keys, developed to distinguish members of a specific occupation from members of other occupations, and the predictor keys, developed to predict the quality of performance within that occupation.

Samples used for the development and comparison between keys were selected at random from 453 International Business Machine workers from the states of Minnesota, Wisconsin, North Carolina, New Jersey, and California. Two classification keys, two predictor keys, and one predictor-cum-classification key were developed from Clark's Minnesota Vocational Interest Inventory, using occupational membership, supervisor's ratings of performance on the job, and an index of job satisfaction as criteria. A modification of a technique proposed by Gulliksen was employed in the development of the keys. The general effect of the item selection procedure was to minimize item intercorrelations, and to increase the factorial complexity of the keys.

All the keys were compared in terms of test-retest reliability, and Tilton's percentage overlapping between criterion groups and reference groups. Intercorrelations between the keys and correlations between the keys and supervisor's ratings were computed. The relationship between achievement and job satisfaction was considered.

Despite the fact that the number of items in each key varied from 41 to 60 it was possible to obtain adequate reliabilities and low standard errors of measurement for these keys. The data obtained with the classification keys showed that I.B.M. workers could be differentiated quite effectively from the reference group of tradesmen-in-general. In addition, the percentage overlapping between the criterion group and the reference group was reduced still further when the criterion group was comprised of only those workers who expressed satisfaction with the job.

Both the predictor keys showed considerable overlapping between high achieving and low achieving I.B.M. workers; perhaps due to the fact that high achieving and low achieving I.B.M. workers were not dissimilar in interest as are, for example, I.B.M. workers and tradesmen-in-general. The predictor-cum-classification key which was developed to differentiate between high achieving and low achieving I.B.M. workers, and also to differentiate between I.B.M. workers and tradesmen-in-general, turned out to be inferior to all the other keys, classification, and predictor.

The classification keys showed no correlation with supervisor's ratings of performance on the job. On the other hand, correlations significant at .01 level were obtained between supervisor's ratings of job performance and scores on the predictor keys. Since interest measures and scores on ability or other aptitude tests generally correlate close to zero, it was suggested that the predictor keys might be used along with other devices in a multiple regression equation to improve the overall validity of a test battery in personnel selection.

It was recommended that for purposes of determining the degree to which a man's interests resemble those of established and satisfied workers in an occupation, the classification-type keys would be best to employ. If, however, the objective was to predict the quality of later performance on the job, then the predictor-type keys should preferably be employed. Further, it seems that the commonly held notions regarding interest and achievement not being related in a direct fashion, may be erroneous. In order to find out whether or not interest and achievement are related, the right kind of measures are needed, namely, scoring keys of the predictor-type and not the usual classification-type keys. Even the validity of the usual classification-type keys might be improved considerably by employing measures of job satisfaction along with those of occupational membership.

Microfilm \$2.00; Xerox \$6.20. 129 pages.

JOB PERCEPTION IN RELATION TO VOCATIONAL PREFERENCE

(L. C. Card No. Mic 59-2529)

George Gerald Gonyea, Ph.D.
University of Maryland, 1958

Supervisor: Dr. Thomas M. Magoon

The purpose of this study was to determine the dimensions by which people perceive jobs, and to explore some of the relationships among vocational preferences, occupational choice, and job perceptions.

A Job Perception Blank, based on Case III of Andrews' A-technique, was administered to 118 male college freshmen. For each of 30 job titles selected from the Holland Vocational Preference Inventory, S was asked to choose which one of the remaining 29 jobs seemed most similar. He was also asked to indicate whether he liked, was indifferent to, or disliked each job.

The job perception data were used as a basis for constructing a 30 x 30 matrix of estimated intercorrelations, reflecting the extent of perceived similarity among jobs. This was cluster analyzed to yield 15 job clusters, each presumably reflecting an underlying perceptual dimension or factor. As anticipated, some of the jobs were fairly uniformly perceived by all Ss, while others were ambiguous or multidimensional, appearing in more than one cluster. Fifteen clusters were obtained, ranging in size from two to five members.

Each S was given a Job Perception score for each factor (excepting three doublets not further considered), reflecting the frequency with which that dimension was employed. Each item in the Job Perception Blank was scored for every cluster in which both the stimulus and response jobs appeared.

Each S was next classified according to the perceptual factor most nearly characterizing his stated vocational objective. Nonparametric analyses of variance between groups were made separately for each factor, the expectation in each case being that the highest scores for each factor would occur in the group choosing jobs characterized by that factor. This hypothesis was not confirmed: only one of 12 Kruskal-Wallis H tests was significant, that in the wrong direction.

Job Preference scores were also obtained for each factor for each S. These were simply the number of "Like" minus the number of "Dislike" responses to the jobs in each cluster. The extent of relationship between the Job Perception and absolute Job Preference scores for each factor was tested by means of Chi Square. Most of the correlations were in the predicted positive direction, but only two were significant.

Finally, Job Perception and absolute Job Preference profiles were constructed for each of 25 randomly selected Ss. Rank order correlations were computed to compare each pair of profiles. Fifteen of these were in the expected positive direction; only three were significant.

In general, the results of this study were suggestive, but not conclusive. Failure to obtain more significant results was attributed to statistical difficulties arising from the nature of the obtained factor structure, the non-normality and non-independence of the factor score distributions, and the response bias noted in certain Job Preference data. Proposals were offered for further research, with

suggestions for minimizing some of the problems encountered in this study.

Microfilm \$2.00; Xerox \$4.20. 79 pages.

A COMPARISON OF THREE METHODS FOR KEYING INTEREST AND PERSONALITY INVENTORIES

(L. C. Card No. Mic 59-2371)

Charles Fredrick Schumacher, Ph.D.
University of Minnesota, 1959

Adviser: Kenneth E. Clark

Three methods for keying interest and personality inventories were compared in terms of their ability to classify senior medical students into the specialty areas which those students had selected for postgraduate study. The keying methods under investigation were:

1. Empirical keying, in which items were selected by comparing the responses of each criterion group with a general reference group containing all other criterion groups.
2. Paired-comparison (PC) keying, in which items were selected by comparing the responses of each criterion group with those of every other criterion group individually.
3. Homogeneous keying, in which items were selected to yield scales having high internal consistency, and low correlations with other scales.

The original item pool was the Edwards Personal Preference Schedule (PPS) from which empirical and PC keys were constructed. The keys constructed by Edwards were used as the homogeneous keys in the present study. In constructing empirical and PC keys, items having relatively high internal consistency coefficients and low discrimination indices were discarded.

Subjects employed in the study were 1170 male, senior medical students from 26 U. S. medical schools who chose one of the following areas for postgraduate study: Internal Medicine, Surgery, Psychiatry, Obstetrics, Pediatrics, Research and Teaching or General Practice. 756 subjects were used to construct empirical and PC keys and the remaining 414 served as cross-validation samples which were classified into specialty areas by each keying method.

Classification was accomplished via multiple discriminant analysis and a generalized distance (D^2) analysis, using only the homogeneous keys, was performed for the item-analysis groups.

The PC keys classified 29.7 per cent of all cross-validation subjects correctly while the empirical and homogeneous keys correctly classified 34.7 and 35.0 per cent respectively. Each of these percentages was significantly greater than chance at the .01 level, and the PC keys made significantly poorer percentages of correct classifications than either the empirical or homogeneous keys. No significant difference in percentages of correct classifications was found between empirical and homogeneous keys.

Neglecting the general practice group, the PC keys made 49 correct classifications while the empirical and

homogeneous keys made 46 and 30 correct classifications respectively. Again each type of key classified significantly better than chance, but in this situation the homogeneous keys made significantly fewer correct classifications than either the PC or empirical keys.

The generalized distance analysis yielded the following three clusters of groups: Cluster I: Internal Medicine, Surgery, Obstetrics, and General Practice; Cluster II: Pediatrics and Research and Teaching; Cluster III: Psychiatry.

Profiles of group means indicated that the three clusters differed considerably on the following homogeneous scales: N. ach., N. ord., N. aut., N. int., N. aba., N. end., and N. agg.

In addition, it was noted that the PC method selected different items than the empirical method from a common item pool, and that individual items were used in a greater number of keys under the PC method than under the empirical method.

Microfilm \$2.00; Xerox \$4.80. 92 pages.

MANIFEST NEEDS AND VALUES AS RELATED TO VOCATIONAL DEVELOPMENT

(L. C. Card No. Mic 59-1651)

Edward Oron Treesh, Ph.D.
Purdue University, 1959

Major Professor: Norville M. Downie

The Edwards Personal Preference Schedule and the Allport, Vernon, and Lindzey Study of Values were administered to 145 teacher trainees enrolled in a course in educational psychology. Ninety-two teacher trainees whose Consistency score was eleven or above on the Edwards Personal Preference Schedule were selected for the sample. The data for each trainee were entered into the appropriate cell of a $2 \times 2 \times 2$ analysis of variance design for disproportionate frequencies. The first of the three factors utilized for classification was sex. The second was the relative time of entry into the teacher training program as indicated by change or no-change of option and/or school within the university setting. The third was the relative degree of commitment to entry into teaching following graduation, decided vs. undecided.

The assumption of homogeneity of variance for the 21 test variables was tested by means of Bartlett's test for disproportionate frequencies. The assumption was tenable for 16 variables which were studied by analysis of variance. Significant second-order, first-order, and main effects were observed on thirteen test variables. These findings were discussed with particular attention to the interactions.

A schema for classifying relative degree of vocational stability was outlined by the investigator. Four groups, ranging from most to least in stability, for each sex were outlined. Mean scores for these groups on test variables for which significant results were observed were graphed for inspectional purposes. Contrary to expectations that the most and least stable groups would differ considerably in scoring patterns, it was found that they were the most similar of the four groups. The trend was the same for

both males and females of the sample. The two other groups, intermediate in stability, also had similar profiles. Tentative interpretations of these scoring patterns were offered.

A design to test the hypothesis that the most and least group members are more likely to accept employment as teachers was outlined. Due to interaction observed, a $2 \times 2 \times 2 \times 2$ analysis of variance design was outlined for study of data available on Guilford-Zimmerman Temperament Survey variables for trainees who have been in the teacher trainee program.

Microfilm \$2.00; Xerox \$5.00. 100 pages.

AN EMPIRICAL ANALYSIS OF THE BELIEF REFERENTS OF PERSONS WITH OPEN AND CLOSED COGNITIVE SYSTEMS

(L. C. Card No. Mic 59-1343)

Robert N. Vidulich, Ph.D.
Michigan State University, 1958

Supervisor: Milton Rokeach

The purpose of the present investigation was to study three parameters of the social referents of persons with open and closed cognitive systems. The "reference group" concept was reformulated within a cognitive-theoretical framework. "Belief referents" were conceptualized as the authorities used by the individual to substantiate his systems of beliefs (positive referents) and disbeliefs (negative referents). Three dimensions on which belief referents could vary---narrowing, differentiation, and isolation---were derived from Rokeach's cognitive theory, which deals with open-to-closed cognitive (belief) systems. It was generally hypothesized that persons with relatively closed cognitive systems would manifest increased narrowing, decreased differentiation, and increased isolation of their belief referents, in comparison with individuals with relatively open cognitive systems.

One-hundred ninety-seven introductory Psychology students were given the Dogmatism scale, the index of openness-closedness of cognitive systems. The obtained split-half reliability of .76, using a signed scale with no filler items, is comparable to previously-obtained reliabilities with padded scales administered under anonymous conditions.

From the total pool, extreme groups of thirty High and thirty Low Dogmatic subjects were selected and tested with an hour-long interview schedule designed to provide measures of the three conceptual dimensions of belief referents. The topic of this schedule was public-school desegregation. Standard procedures were used for all subjects. Multiple analysis of covariance was used to remove age and intelligence variations between the two groups.

As a measure of the narrowing dimension, all subjects named, on five separate indices, all personal acquaintances, public persons, and groups who were perceived as favoring or in opposition to their own position on the integration topic. In accord with the proposed hypothesis, subjects with relatively closed cognitive systems were found to have fewer negative belief referents than subjects

with relatively open cognitive systems. This discrepancy was mainly a function of reduced awareness of public persons opposing the closed subjects' beliefs.

To test the differentiation dimension, (1) All subjects were given information tests about the public persons and groups who served as positive or negative belief referents. The finding that subjects with relatively closed cognitive systems had no less knowledge about their negative belief referents relative to their positive referents than did persons with relatively open cognitive systems did not support the proposed hypothesis, (2) All subjects rated their negative belief referents on degree of similarity. No significant differences were found between the two groups in the extent to which negative referents are perceived as similar, or undifferentiated. The proposed hypothesis was thus unsubstantiated.

Two indices were also obtained for the isolation dimension: (1) All subjects cited the sources of information about their negative belief referents. Three source-categories were used: "personal contact" with the negative referent or his statements, mass media, or other positive referents. There was no significant support for the hypothesis that persons with relatively closed cognitive systems should obtain less information about their negative referents directly from these referents than persons with relatively open cognitive systems. The results, however, indicated that the relatively closed subjects tended to use direct sources less for negative belief referents than for positive referents. (2) One-half of each group rated identical statements, attributed to either a positive or a negative belief referent, on an acceptance-rejection scale. It was hypothesized that persons with relatively closed cognitive systems would show greater acceptance of pronouncements of a positive referent and greater rejection of pronouncements of a negative referent than subjects with relatively open cognitive systems. Findings in the opposite direction from that anticipated were obtained. Relatively closed subjects showed greater acceptance of statements attributed to both positive and negative referents.

Thus, significant evidence was obtained for only one of the three proposed conceptual dimensions. High polarization of belief on the desegregation issue was evident in the sample used; this tended to confound variations on the cognitive dimension of openness-closedness used to isolate the experimental groups. While the lack of prior analyses of the three conceptual dimensions used also limits the generalization of these results, the investigation provides inferential evidence for the utility of the proposed reconceptualization of reference groups as cognitive belief referents.

Microfilm \$2.00; Xerox \$6.00. 122 pages.

AN INVESTIGATION OF PROBLEMS PRESENTED BY PHYSICALLY HANDICAPPED ADULTS

(L. C. Card No. Mic 59-1656)

George Nelson Wright, Ph.D.
Purdue University, 1959

Major Professor: Hermann H. Remmers

It is a common observation that substantial physical disability is the source of many extra problems to the

individual. Beginning with the fundamental assumption that disability is a frustrating state of affairs, the literature of somatopsychology is replete with attempts to measure personality variation attributable to these special frustrations or problems. There are many informal accounts but no one has systematically collected and analyzed the problems associated with conditions of physical impairment.

The general purpose of this research was to provide better knowledge of the problems a selected group of physically disabled people attribute to their impairment. The study is based upon random samples of non-blind physically disabled clients of the Indiana Vocational Rehabilitation Division.

Specific objectives of the investigation were: 1) to collect a comprehensive list of the general problems of physical disability and to determine the incidence of those problems according to the self report of the selected population; 2) to develop an instrument to measure these problems; and 3) to discover relationships between a series of organismic variables and problems in four context areas.

Handicap problems were identified by the administration of a specially constructed open-end sentence completion test to a sample of rehabilitation clients who varied widely as to age, type of disability, education, and other variables. These statements about the effects of disability were converted into item form with slight editorial changes. The resulting list of problems were then categorized by a panel of 27 psychologists into four context areas - personal, family, social and vocational - later to become subtests. Further item refinements were made by subjective and by psychometric techniques based upon a pretest of the instrument. The final form of the instrument, which has been named the Handicap Problems Inquiry, consists of 280 items divided into four subtests as mentioned above.

The Handicapped Problems Inquiry was administered by mail to a sample of Indiana Rehabilitation Division clients. The 1027 completed forms, constituting an 84.3 per cent return, are the bases for the remainder of the analyses reported below. Internal consistency reliability coefficients for the four subtests ranged from .91 to .95. The actual frequency of each of the 280 problems is reported according to nine specific kinds of disability and for the total sample. Percentile norms have been compiled. Composition of the sample was thoroughly analysed for users of these norms and for more adequate interpretation of the obtained results.

A series of hypotheses were tested to determine relationship between frequency of problems in the four context areas and organismic variables of the population of rehabilitation cases studied. Null hypotheses stated for the following variables were refuted at or beyond the five per cent significance level, i.e. the following relationships are indicated: 1) sex with vocational problems, 2) marital status with family and vocational problems, 3) education with personal, family, social and vocational problems, 4) age with family and vocational problems, 5) duration of disability with family, social, and vocational problems, 6) the presence of a second disability and personal, family, social and vocational problems, 7) type of disability with personal, family, social and vocational problems, 8) income source with personal, family, social and vocational problems, 9) socio-economic level with vocational

problems, 10) urban-rural residency with personal and vocational problems, 11) tally (duration of rehabilitative services) with vocational problems, 12) status (type of rehabilitative service) with personal, family and vocational problems, 13) rehabilitation counselor with family, social and vocational problems. No relationship was found between handicap problems (as expressed by any of the four subtests) and either religious affiliation or etiology of the disability (disease, accident or congenital).

Microfilm \$2.20; Xerox \$7.80. 167 pages.

PSYCHOLOGY, CLINICAL

HOSTILITY CONFLICT AND CERTAIN COGNITIVE PROCESSES

(L. C. Card No. Mic 59-1978)

Edward S. Butler, Ph.D.
The University of Bullalo, 1959

This study was designed to investigate relationships between hostility conflict and cognitive functioning.

The major position, derived from Schafer and Wiener, asserted that Rorschach hostility content (RHC) scores could be used to predict behavior on cognitive tasks in a manner similar to Wiener's use of the Sentence Completion Test. This position maintained high RHC percentages indicated a "sensitizing" defense; whereas, low RHC percentages indicated a "repressive" defense to hostility conflict in hospitalized psychiatric patients who, presumably, have marked hostility conflicts.

It was expected that, compared with psychiatric repressors, psychiatric sensitizers would: (1) recognize hostile words more quickly; (2) maximize hostility in stories; and (3) obtain higher Sentence Completion Test hostility scores.

One alternative position maintained that high RHC only indicated hostility conflict and that high RHC patients would simply manifest high word recognition variability.

A second alternative position asserted that conflict resulted in inefficiency and psychiatric patients would recognize hostile words less quickly than would normal subjects.

To test these notions the following material was used: (1) DeVos' Rorschach hostility content (RHC) scale; (2) a Sentence Completion Test similar to Wiener's; (3) a Word Recognition Task which utilized the carbon-copy technique; and, (4) a Thematic Hostility Impression Task which consisted of four stories describing hostile and non-hostile interpersonal interactions, with a check list for recording impressions.

The subjects included thirty (30) High RHC and thirty (30) Low RHC, hospitalized, male, psychiatric patients. Also, thirty (30) normal subjects were obtained from medical wards of a Veterans Administration Hospital.

The major findings were:

1. a. The major position, as stated, is not supported by the WRT recognition score data. The High and Low RHC groups do not differ on their hostile or neutral word scores. This finding may be questionable, however,

because the WRT does not appear to be a "sensitive" test and may be unreliable.

b. The alternative positions fail to receive support from WRT data. The groups do not differ with regard to variability, nor do the psychiatric groups perform less efficiently than the Normals.

2. Further analyses do suggest a more complex relationship between conflict and cognitive responses than had been supposed.

a. The RHC scale and the SCT appear to be related. The two RHC group's SCT scores differ, but each does not differ from the Normal.

b. The two RHC groups differ in their number of WRT pre-recognition hypotheses (incorrect guesses) of all types; and, more important, of hostile guesses only. Each group, however, does not differ from the Normals.

c. Although over-all THIT hostility scores among the three groups do not differ, there are differences on each separate story. The High RHC group maximizes hostility on the hostile stories and minimizes it on the non-hostile stories. The opposite is the case for the Low RHC group.

Considerable support was found for a relationship between hostility conflict and cognitive functioning in psychiatric patients, but this relationship is more complex than had been supposed. Variables such as: the ambiguity of the stimulus; the actual nature or content of the stimulus; and, perhaps, the level (e.g. perception, memory, or interpretation) of the task should be specified when statements or predictions about such relationships are made.

Several areas for subsequent research were discussed including: fundamental definitional and methodological problems concerning "perceptual defense"; relationships between Rorschach content and the Sentence Completion Test; and further work with the promising Thematic Hostility Impression Task. Increased attention might be paid to the relatively neglected areas of memory and, especially, judgement. These processes seem to permit a greater influence of personality variables upon responses. Also tasks can be more readily designed to approximate the life situations from which concepts such as conflict and defense were originally obtained.

Microfilm \$2.00; Xerox \$6.40. 131 pages.

SIGNIFICANT THERAPEUTIC ACTIVITY IN RELATION TO OUTCOME

(L. C. Card No. Mic 59-2011)

Eugene Dale Chambers, Ph.D.
University of Illinois, 1959

Much clinical lore and a few research studies suggest that significant verbal activity on the part of both client and therapist regarding the client's problems should have a high positive relationship with favorable therapeutic outcome. This study was designed to test the hypothesis that this is actually the case.

A method for measuring the degree to which client and therapist engage actively in exploration of significant aspects of the client's problems was devised. Content variables derived from an analysis of areas of agreement

among many current schools of psychotherapy, and from studying transcribed interviews were presented to thirteen clinical judges and scaled by the method of Rank Order. Ratings of the amount of active participation of client and therapist relevant to these content variables were made by two judges. Ratings were made for an early and a late therapy interview, for twenty-six cases, and composite "Significant Activity" scores were obtained from these ratings.

"Significant Activity" scores for client and therapist were related to criteria of rated therapeutic movement, improvement in client self-evaluation, and the length of therapy. In order to determine whether or not criteria were measuring a general variable of improvement, inter-relationships between these were obtained. These were all low, which suggests the advisability of using multiple criteria in outcome research. Relationships between "Significant Activity" scores and the three criteria failed to support the general hypothesis that active exploration of significant problem material would be associated with shorter therapy and greater improvement. Although no significant relationships were found between "Significant Activity" scores and either rated therapeutic movement or improvement from pre- to post-therapy in client self-evaluation ratings, significant negative correlations between "Significant Activity" and the client's initial self-evaluation were found, suggesting that both client and therapist tend to be more active in exploring problem material when the client's initial self-evaluation is low.

When the sample was divided on the basis of client initial self-evaluation scores, the high self-evaluation group showed significantly lower "activity" scores than did the low self-evaluation group. This high self-evaluation group was found to account for the negative relationship between initial client evaluation and "Significant Activity" scores for client and therapist. Results also indicated that to the extent that clients in this high self-evaluation group were "active", they tended to show less change or actual decrease in self-evaluation over therapy, although this result just missed being significant. In contrast, the low self-evaluation group showed no consistent relationship between amount of "activity" and self-evaluation scores. Inspection of transcript material suggested that these groups may have involved somewhat different kinds of client problems.

An additional analysis was made comparing relationships between "activity" scores and criteria for groups involving greater versus lesser judged "Integrated Interaction". The hypothesis that these relationships would be higher for the "High Interaction" group than for the "Low Interaction" group was not substantiated. These results further suggested that "Significant Activity" under "High Interaction" conditions was associated with lack of improvement or decrease in client self-evaluation.

It was concluded that "Significant Activity" as defined in this study was not in general related to therapy outcome, except as it may have contributed to decreased self-evaluation in some kinds of client problems. The possibility was suggested that favorableness of client self-evaluation may not be a good index of the success of therapy. Of even greater potential significance for the conduct of therapy is the possibility that "Significant Activity" on the part of either client or therapist may not be the important variable in successful therapy. Other variables such as the client-therapist relationship, the

emotional climate of therapy, and covert communication processes may play a more important role. These were suggested as possible emphases for further research.

Microfilm \$2.00; Xerox \$4.00. 75 pages.

THE RELATION OF SELF-ACCEPTANCE BEHAVIOR TO THE SOCIAL LEARNING THEORY CONSTRUCT OF NEED VALUE

(L. C. Card No. Mic 59-1613)

Douglas Prescott Crowne, Ph.D.
Purdue University, 1959

Major Professor: Mark W. Stephens

This study was designed in an attempt to predict self-evaluative behavior from a knowledge of the relative strength of certain defined needs and from expectancies, and to provide an explanation in terms of social learning theory for the predictions. The rationale for the primary hypothesis was developed around the view that self-evaluative behavior is influenced by social consequences and that a person's reported self-acceptance, as distinguished from self-acceptance on an inferential level, is a function of patterns of social reward and punishment.

Two need constructs were developed which appeared to incorporate self-acceptance behavior. The first of these was the need to be perceived as self-devaluing, which was defined by behaviors directed toward the achievement of such satisfactions as support, encouragement and succorance from others and protection against failure or punishment as a result of self-assertion. The second need construct was termed denial of inadequacy. Need to be perceived as free from inadequacy is seen in behaviors directed toward rewards of recognition and prestige, dominance or leadership of others and relative immunity from criticism or punishment. It was assumed that how a person thinks others perceive him is associated with the occurrence of social rewards and punishments and is itself a reinforcement which influences behavior.

The major hypothesis was as follows: Low self-accepting or "self-rejecting" behavior is associated with high preference for being perceived as self-effacing; highly self-accepting behavior is associated with high preference for being perceived as free from inadequacy.

A test, the Need Value Scale, based on theoretical and psychometric models, was devised to measure the need constructs. The measure of self-acceptance behavior was a questionnaire employing items used in Q-sort studies by Butler and Haigh and other co-workers of Rogers. Other measures used included a test of freedom of movement within the need areas proposed, a test of acceptance of others, a test of adjustment (Rotter Incomplete Sentences Blank), measures of six need areas proposed by Rotter, and statements of minimal academic goal and expectancy for academic success. These additional measures were included in an effort to (1) assess the generality of self-acceptance behavior; (2) determine relationships of self-acceptance behavior to variables internal and external to social learning theory; and (3) broaden the base of prediction of self-acceptance behavior.

Subjects used in the study were 130 undergraduate

students enrolled in an introductory psychology course at Purdue University.

Results did not support the major hypothesis as formulated. It was found that both need to be perceived as self-devaluing and need to be perceived as free from inadequacy were associated with extreme self-acceptance behavior. Subjects having high preference for being perceived as self-devaluing or free from inadequacy tended to report non-normative self-acceptance, but the direction of deviation could not be predicted according to present results. The need construct of self-devaluation was found to be significantly related to social learning theory needs for protection-dependency and love and affection. Denial of inadequacy was found to be significantly associated with dominance and independence needs in the social learning theory framework.

Freedom of movement and the need constructs proposed were found to be independent, and freedom of movement did not correlate with the social learning theory need areas. This is consistent with theoretical expectation.

Need to be perceived as self-devaluing or free from inadequacy did not relate as predicted with maladjustment. Self-devaluation appeared primarily to be associated with relative lack of maladjustment, while subjects having high preference for denial of inadequacy tended to obtain very high or very low maladjustment scores. Low reported self-acceptance was found to be associated with maladjustment and related to low acceptance of others. Both self-devaluation and denial of inadequacy were found to be associated with low acceptance of others as predicted.

It was suggested that the proposed need constructs conformed moderately well with theoretical expectation and appear to show promise for future research.

An interpretation of the findings in terms of relative lack of generality and situational specificity of self-acceptance behavior was suggested, and tentative hypotheses for further research were proposed.

Microfilm \$2.00; Xerox \$6.40. 132 pages.

THE EFFECT OF CHANGES IN CERTAIN DETERMINANTS OF GROUND UPON THE PERCEPTION OF BETA MOTION

(L. C. Card No. Mic 59-1725)

Herbert Carlton Hart, Ph.D.
The University of Florida, 1959

The purpose of this study was to investigate the changes produced in certain measures of Beta motion by the introduction of vertically barred, horizontally barred, and non-figured grounds. The measures used were flash-rate for the lower and upper limens of motion, rate for optimal motion, and range of flash-rates within which Beta motion could be seen.

The data were subjected to a statistical analysis consisting of the computation of the means, standard error of the means, standard deviations of the distributions, Pearson product-moment correlation coefficients, *t* ratios between pairs of means, and four complex analyses of variance.

It was found that there were no statistically significant differences between means for the various grounds for the

lower flash-rate threshold and the optimal rate. Statistically significant differences were found for the upper limen and for the range between the figured and the non-figured grounds. Statistically significant r_s were found on all the pairs of measures except optimal rate.

A Gestalt interpretation of Beta motion on the basis of prägnanz and of isomorphism was questioned. The findings seem to indicate that the temporal pattern of stimulation seems related to Beta motion as investigated in this study. Microfilm \$2.00; Xerox \$3.00. 55 pages.

MANIFESTATIONS OF HOSTILITY IN NEURODERMATITIS

(L. C. Card No. Mic 59-1489)

Max Michael Klaber, Ph.D.
Columbia University, 1959

Substantial clinical evidence suggests that patients afflicted with neurodermatitis suffer from a personality disturbance in which the suppression of intense hostility is a central feature. This research was designed to obtain empirical evidence concerning the manifestations of hostility on overt and covert levels in such patients.

It was hypothesized that neurodermatitis patients (a) evidence no more hostility than control subject, suffering from nonpsychosomatic skin diseases on an instrument tapping overt behavior; (b) neurodermatitis patients manifest more hostility on a covert measure of hostility than the control subjects; and finally (c) that neurodermatitis patients differ in verbal hostile responses on a conditioning task.

A battery consisting of three tests was administered to twenty neurodermatitis patients and twenty control subjects, patients suffering from exogenously caused dermatoses. A Manifest Scale of Hostility, previously used in research with neurodermatitis patients, was used to gauge overt hostility. Stories told to seven TAT cards served as measures of covert hostility. In order to elicit reinforcing verbal responses, a sentence completion task was constructed. On each of 74 stimulus cards four verbs were typed, one of which was of hostile stimulus value. The subjects were presented with one card at a time and were instructed to construct one sentence using any one of the four verbs. The conditioning procedure was designed in the usual manner: operant (unreinforced), conditioning (reinforced), and extinction (unreinforced). Reinforcement was verbal.

The results were consistent with all three hypotheses. No difference between the two groups was found on the Manifest Scale of Hostility, but the low reliability of the Scale (.40) does not permit more than a tentative acceptance of the null hypothesis. Differences on the TAT, as rated by two independent clinicians, were significant at the .01 level with respect to both higher mean and larger variance in favor of the neurodermatitis group. On the Sentence Formation Task the control patients emitted significantly more hostile responses on the operant base level than the experimental subjects. The experimental subjects increased their hostile responses under reinforcement, reaching a level equal to that of the control subjects. Some of the implications of the methodology with respect to future research were discussed. Microfilm \$2.00; Xerox \$3.00. 41 pages.

THE STABILITY OF PERFORMANCE OF SCHIZOPHRENICS ON THE DRAW-A-PERSON TEST

(L. C. Card No. Mic 59-2340)

Leon Leppel, Ed.D.
Temple University, 1959

This study dealt with the consistency of performance of a group of hospitalized schizophrenics on the Draw-A-Person test.

Fifty hospitalized schizophrenics and sixty-nine college students were administered the DAP test (Draw-A-Person). Both groups were retested approximately one week from the time of the first administration. The schizophrenic patients were administered the DAP test individually, the non-pathological subjects were tested in groups.

The variables used in this study were selected mainly from those hypothesized by Machover as being relatively stable. These variables were: size of figure, length of arms, size of head, placement, type of line, erasures, shading, omissions and method of clothing.

Each drawing was rated separately for each variable. Two types of comparison were made for the drawings of each subject. First, the ratings of each variable of the two figures of the same sex were compared. Then the ratings for each variable of the two figures, male and female, drawn at one session were compared. When a change occurred between drawings, it was recorded.

In the process of scoring the variables, certain instruments and devices were constructed and used. These were a clear plastic placement- and size-scoring plate, and two double calipers for measuring the proportion of the head to the trunk.

The following conclusions or general statements were made:

1. The schizophrenics tend to draw their figures in much the same manner on the second test as they did on the first test.
2. The normal subjects also show a tendency to draw their figures much the same way on the second test as they did on the first.
3. In comparing the number of test-retest changes made by schizophrenics with those of normal subjects, significant differences were, for the most part, not in evidence.
4. The schizophrenics do not appear to be any more or any less inconsistent on male figure drawings than on female figure drawings.
5. The normal group showed a similar trend and did not appear to be any more or any less inconsistent on male figure drawings than on female figure drawings.
6. The schizophrenics showed a tendency toward drawing the male figure and the female figure in a similar fashion with respect to selected variables.
7. The normal group also showed a tendency toward drawing the male figure and the female figure in a similar fashion with respect to selected variables.
8. The schizophrenic and normal groups do not appear to differ significantly in the number of changes made between drawing a male figure and a female figure.

Microfilm \$2.00; Xerox \$4.60. 88 pages.

THE DIFFERENTIAL EFFECT OF CENSURE ON THE PROBLEM SOLVING BEHAVIOR OF SCHIZOPHRENIC AND NORMAL SUBJECTS

(L. C. Card No. Mic 59-1983)

Stuart Melvin Losen, Ph.D.
The University of Buffalo, 1959

The present study was designed to determine the differential effect of "censure" upon problem solving performance in "good pre-morbid" schizophrenics and normal hospitalized patients. The subjects' performances on arithmetical reasoning problems, and on digit span tasks involving attention and immediate recall were studied. These materials were employed because of their presumed sensitivity to variations in attentiveness. (Results from a separate experiment were reported confirming that the arithmetical reasoning task was sensitive to experimentally induced distraction.)

Methods were employed, in the present study, which were designed to direct attention to the task and thus produce performance increment by censuring the subjects' incorrect responses. The censure employed was mild, consisting of such statements by the examiner as "No, that was wrong. You probably didn't concentrate or listen carefully enough. Now listen carefully to this next problem."

The relative effects of varying the regularity of censure were explored by studying comparative schizophrenic group performances under four experimental conditions, i.e., 100% (continuous) censure, 50% (periodic) censure, 0% (no) censure, and an Information-only condition in which subjects received the correct answers to the problems without censure or comment. In the case of schizophrenic subjects, under the experimental conditions of 100% censure and 50% censure, two subsequent testing sessions without censure were employed to study the extinction of changes produced during training.

Three normal control groups, matched with the schizophrenic groups for initial arithmetical reasoning ability, were studied under conditions of 100% censure, 0% censure, and under the information-only condition. It was predicted that performance increment would not be obtained with the normal groups on the assumption that normal subjects would probably be performing at close to their maximum capacity initially.

In agreement with expectation, no significant increment or decrement was obtained under the experimental conditions with any of the normal groups on either the arithmetical reasoning, or digit span tasks. In contrast with their lack of effectiveness with normals, the experimental conditions produced significant performance changes in the schizophrenic groups. Both the 100% and 50% censure groups showed significant performance increments on both the arithmetical reasoning and digit span tasks. That this improvement might be attributed to increased motivation, or to the effectiveness of training upon their set to attend to the task, was supported by the fact that the schizophrenic 0% and information-only groups showed no significant performance increments on any of the tasks. The major hypothesis, therefore, that censure would effect an increment in the performance of "good pre-morbid" schizophrenics was confirmed.

An analysis also was made of the differential rate of extinction of the act of attending to the task for schizophrenic

subjects under the 100% and 50% conditions. It was found that there was a significant interaction in the predicted direction of greater resistance to extinction in the 50% group.

Specific findings and qualitative analyses of the subjects' reactions to censure were also reported, and the results were discussed concerning implications for theory and certain methodological problems.

Microfilm \$2.00; Xerox \$5.60. 115 pages.

A STUDY OF THE EFFECT OF NEED VALUE ON SUBSTITUTION

(L. C. Card No. Mic 59-2294)

Antionette Bardwell Lotsof, Ph.D.
The Ohio State University, 1953

Substitution arises when one satisfaction takes the place of another so that the individual no longer strives for the original satisfaction. Much of the previous work done on substitution utilized the theoretical formulations of Lewin.¹ The Lewinian approach postulates that when an individual is presented a task, a "quasi need" or tension is created in the individual. When this task is completed the tension is reduced. However, it is possible for another task to substitute for the original task that has been interrupted, and the second task may dissipate the tension.

The paradigm for the study of substitution by using the above theoretical rationale is: (1) present a task to the subject, (2) interrupt the task, (3) present a second task to the subject which he is allowed to complete, (4) allow time for the subject to resume the original task if he so desires. It is assumed that a second task may act as a substitute for the interrupted task and dissipate the tension. The criterion of whether such a task would act as a substitute is determined by whether or not the first task is resumed. If the first task is not resumed it is presumed the tension has been dissipated and the second task acts as a substitute for the first. However, if the first task is resumed, the second task is presumed not to have dissipated the tension, and the second task does not act as a substitute.

Many of the previous studies using this type of theoretical formulation have been concerned with the characteristics of a task which will act as a substitute for the first. However, some of the findings have not been consistent, and the meaning of resumption or non-resumption has not been clear. The studies done under Lewin² were concerned with a single effect—the decreased resumption as a result of drive reduction. Nowlis,³ Rosenzweig,⁴ and Child and Grosslight⁵ called attention to the opposite effect—the increased resumption as a result of reinforcement.

The social learning theory, as formulated by Rotter,^{6, 7, 8, 9, 10} seems to offer some theoretical concepts which might reconcile what appears to be differences in results of these previous studies. In the social learning theory, behavior is seen as goal-directed, and the prediction of an individual's behavior in any specific situation requires a knowledge of the needs brought into play and the different ways these needs can be satisfied for this individual. Needs are differentiated from unlearned drives, in that the tendency toward movement is determined by the presence

of correct cues or stimuli rather than by an internal condition describable only on a physiological level. This theory rejects the notion that such psychological goals must be explained in terms of their leading to the satisfaction or neutralization of physiologically described drives, resulting in the reduction of those drives. A need is not defined as an internal state of the individual, but is inferred from behavior.

In order to predict or account more accurately for behavior, the social learning theory utilizes three basic constructs: "behavior potential," "expectancy," and "reinforcement value." The potentiality of a behavior to occur is a function of the expectancy that this behavior will lead to a reinforcement, and of the value or importance that reinforcement has for the individual. Prediction is not necessarily dependent upon the knowledge of the value of each reinforcement in the individual's life. It is held that the value of various reinforcements may be predicted from the value of other reinforcements on the basis of functional relationships among them.

The dissertation is concerned, not with predicting a single behavior, but a group of functionally related behaviors, and not all their possible consequences, but the degree to which these behaviors are used to obtain one of a set of functionally related reinforcements. The potentiality of a set of behaviors occurring which lead to the satisfaction of some need is a function of the freedom of movement or expectancies of these behaviors leading to the reinforcements of the satisfaction of this need and the strength or value of these reinforcements or needs. This is expressed as:

$$N.P. = f(F.M. \text{ and } N.V.)$$

Need potential (N.P.) is a function of freedom of movement (F.M.) and need value (N.V.). Need potential, freedom of movement, and need value are expressions of mean value of behavior potential, expectancy, and reinforcement value, respectively.

The method for studying substitution in this investigation is characterized by blocking the individual from gaining a reinforcement and offering him several behaviors leading toward other reinforcements. The subject then selects from these alternatives the one he would most like to do.

The major hypothesis investigated states that individuals who are blocked from gaining a goal in a need in which the need value is higher for them than another need area will substitute behaviors directed toward a functionally related goal rather than behaviors directed toward a non-functionally related goal if the expectancies for all alternative goals are equal.

The minor hypothesis states that although the need value for individuals is high in a given need, individuals may categorize a specific situation as one where there is more potentiality for satisfaction of a lesser need. Consequently, the tendency to select behaviors leading to reinforcements commensurate with the stronger need is modified and they tend to select such behaviors less often than when blocked from gaining a goal in the higher need area.

The needs utilized for the present study were: (1) the need for acceptance and liking by peers of the same sex, and (2) the need to be considered competent, to obtain status, in academic work.

PROCEDURES

Development of the Measuring Instrument

A measuring instrument which would elicit substitute behavior related to the two needs was developed. This instrument consisted of both academic and social hypothetical situations in which a goal was denied an individual. Alternative behaviors (the same number directed toward the satisfaction of both needs) accompanied the situations and the subjects were to select the alternative behavior they preferred in place of the goal denied them in the original situation. These situations and alternative behaviors were similar to common experiences of the subjects. The subjects for the entire study were all white, female college students who were registered in a beginning psychology course at the Ohio State University.

The first step in developing the measuring instrument consisted of writing out on individual slips of paper only the alternative behaviors. These were grouped into sets, each set consisting of the behaviors for one situation. These sets were presented to a group of 65 subjects who ranked the behaviors in each set according to preference value. The mean preference values of two behaviors directed toward academic recognition were matched with the mean preference value of two behaviors directed toward affection from same sex peers. There was no significant difference between these two mean values.

The next step consisted of writing out the 10 hypothetical situations on separate sheets of paper with their four accompanying alternatives (the two social and the two academic with equal mean values). The alternative behaviors were randomized in order of their appearance on the page and the hypothetical situations were randomized in the order of their presentation.

These situations and alternative behaviors were given to 51 subjects with the instructions to select their first, second, third and fourth choice of alternatives in place of the behavior that was barred them in the original situation. This task was presented to the subjects as the development of an interest test and it was emphasized that the experimenter was not interested in which of the alternatives they felt they should select, but rather in which alternatives they like best to do, second best to do and so on. As all alternative goals were presented as being equally possible it was felt that the expectancies the individuals had for each were held approximately equal.

Again the mean preference value for the two alternative behaviors directed toward satisfaction of the academic recognition need were compared with the mean preference value for the two alternative behaviors directed toward affection for same sex peers. If this difference was significant, that situation and alternative behaviors and goals were dropped from the instrument. The final form of the measuring instrument consisted of three hypothetical situations in which the individual was blocked from gaining a goal in the need of academic recognition and three hypothetical situations in which the individual was blocked from gaining a goal in the need for affection from same sex peers. For each of these six hypothetical situations there were two alternative behaviors directed toward a goal in the one need and two alternative behaviors directed toward a goal in the other need.

Experimental Design

This experiment consisted of comparing the relative need value of the subjects for academic recognition and

affection from same sex peers with the choices for substitute behavior. The relative need value of the two needs was evaluated for the 85 subjects by means of half-hour clinical interviews. Three judges rated 30 randomly selected interviews, assigning a rating of 4 or 5 to individuals who seemed to have a higher need value for academic recognition than affection from same sex peers, a rating of 1 or 2 for individuals having a higher need value for affection from same sex peers than academic recognition, and a rating of 3 for individuals who seemed to have a need value about equal for the two needs.

Pearson Product Moment correlations between judges' ratings indicated that there was reasonable agreement among them. The experimenter's ratings were used as criterion and she rated all 85 interviews.

The 85 subjects were also presented the measuring instrument in the same manner as was done in the pre-testing and they were to select their first, second, third, and fourth choices of the alternative behaviors. The interview and the presentation of the measuring instrument were done at two different times and were represented as two entirely different experiments. The preference ratings on the measuring instrument were weighted with the first choice being given a weight of four, second choice, three, third choice, two, and fourth choice, one. The sums of the weighted scores were used in assigning subjects to categories in the Chi squares, and the sums of first choices only were used to assign individuals to categories in other Chi squares.

RESULTS

Analysis of the data indicated that group III (those subjects rated as having equal need value for the two needs) selected a preponderance of social substitute behavior. According to the hypotheses this group should show no consistent preference for social or academic substitute behavior. Therefore, it was felt that the clinical interview and the judges' manual were not fine enough instruments to differentiate group I (those individuals having a higher need value for affection from same sex peers) and group III (equal need value). These two groups were combined and considered one group, group I. Group I consisted of 54 subjects while group II (rated as having higher need value in Academic Recognition) had an N of 31.

Table I summarizes the statistical results obtained in this study. The findings were:

1. Socially oriented individuals tend to select socially oriented substitute behaviors while academically oriented individuals tend to select academic substitute behaviors when considering both kinds of hypothetical situations.
2. When barred from gaining a goal in affection from same sex peers, the socially oriented individuals tend to select as alternatives behaviors directed toward functionally related goals more often than did academically oriented individuals in the same situations.
3. When barred from gaining a goal in academic recognition, the academically oriented individuals tend to select as alternatives, behaviors directed toward functionally related goals more often than socially oriented individuals in the same situations.
4. When faced with social situations, individuals do not seem to select, to a very significant degree, more social substitute behaviors than academic substitute behaviors.

TABLE I

	Weighted Score		First Choice	
	X ²	P	X ²	P
1. Comparison of choices of substitute behavior of social and academic groups for both kinds of situations	11.59	<.001	9.67	<.01
2. Comparison of choices of substitute behavior of social and academic groups in socially oriented situations	11.58	<.001	10.97	<.001
3. Comparison of choices of substitute behavior of social and academic groups in academically oriented situations	7.47	<.01	1.99	>.10
4. Comparison of the combined choices of substitute behavior of the social and academic group in the socially oriented situations	1.83	>.10	5.08	<.05
5. Comparison of the combined choices for substitute behavior of the social and academic groups in the academically oriented situations	48.79	<.001	65.80	<.001

5. When faced with academic situations there is a strong trend for individuals to select more academic substitute behaviors than social substitute behaviors.

The discrepancy between comparisons four and five is probably caused by conditions not completely controlled in the experiment. If the selection of alternative behaviors in terms of need value is modified by the cues present in the situation, then there are more academic cues or stimuli present in the academic situations than in the social situations. Not only were cues or stimuli presented by the hypothetical academic situations, but there were cues present in the entire setting of the experiment. The experiment was carried out in a university building under the auspices of the university. This extra set of cues would tend to accentuate the tendency to select academic alternative behaviors and inhibit the tendency to select social alternative behaviors.

CONCLUSIONS

This study presents another approach to the problem of substitution which is different from approaches used by other experimenters. As needs of an individual can be inferred from his behavior, the preference for substitute behaviors may be utilized in the study of the substitution. Using the concept of need value in the prediction of substitute behavior eliminates the necessity to rely on the assumption of need reduction. The findings of this study indicate that the need value helps determine the substitute goal toward which individuals strive.

The cues or stimuli of the situation may also effect substitute behavior. If the situation is so structured as to be seen by the individual as one where a need of higher value is to be satisfied he will tend to select substitute behavior commensurate with that need. However, if the situation is such that the individual categorizes it as one where another need is more easily satisfied there are indications that the tendency to select behaviors leading to a reinforcement commensurate with the stronger need is modified by the situation. In this study the hypothetical situations furnished the cues to which the subjects reacted. Microfilm \$2.00; Xerox \$6.60. 140 pages.

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A COMPARISON OF EMERGENCE AND VALUE AS DETERMINANTS OF SELECTIVE PERCEPTION

(L. C. Card No. Mic 59-2296)

William Henry Lyle, Jr., Ph.D.
The Ohio State University, 1953

Recent work in the area of perception has dealt increasingly with what has come to be called "projective perception." It is evident from a brief survey of studies dealing with set and attention that this recent interest is

a revival of an interest in the part that the individual plays in the shaping of his own experiences rather than being something new, as it is thought to be. A major share of the current interest in the part that the individual plays in determining what he sees and to which he therefore responds appears to have been stimulated by the clinical psychologists.

The clinicians have been particularly interested in determining the part that the individual's past experiences play in the development of his current attitudes and the manner in which these attitudes affect the individual's present relationships. Current work in projective psychological testing has emphasized the consistency with which the individual responds to his behavioral environment in the face of much less consistency to that environment. Such an emphasis has placed certain assumptions developed from clinical research and qualitative clinical judgment in opposition to some of the more classical work in perception. As Werner and Wapner¹ state,

It is also characteristic that in a widely accepted theory a number of facts might not be covered because they are considered peripheral to the main body of explainable data. These so-called peripheral facts, through a shift in emphasis, may suddenly become crucial and may force a revision in theory. Such a shift can be noted today with respect to the projective characteristics of perception. . . Experimental psychology looked on the problem of projective perception, because of its experimental unmanageability, as unfit for scientific analysis. . . It was mainly the success of clinical psychologists using perception as a diagnostic tool which brought this problem of projective perception into the center of interest.

Bruner and Postman, in a series of studies following an earlier study by Bruner and Goodman² on value and need as organizing factors in perception, have demonstrated that high value is associated with quickness of perception of related words presented tachistoscopically.³ This finding has been confirmed in a similar study by Vanderplas and Blake,⁴ using an auditory presentation, and by Haigh and Fiske,⁵ using methods somewhat similar to those used in the study by Postman, Bruner, and McGinnies.³ Bruner and Postman's research led them to propose the concepts of selective sensitization, perceptual defense, selective vigilance, and value resonance⁶ as temporarily useful concepts in the explanation of their results. Howes and Solomon⁷ took particular exception to the concept of defense and offered an alternative explanation of the results which established a relationship between value and visual duration threshold. They demonstrated that the length of visual exposure required for the recognition of the words presented was related to the Thorndike-Large frequency of these words.⁸

It was the information given regarding value resonance by Postman et al.,³ Bruner and Postman,⁶ and McClelland and Liberman⁹ which stimulated the present study. The first two reports indicated that subjects tended to give words related to the word presented when words symbolizing highly valued areas of behavior were presented and words contrary in value to the work being presented as "guesses" when words related to low value areas were presented. McClelland and Liberman,⁹ contrary to their expectations, has found a high frequency of contravalant "guesses" even when the words presented represented

highly valued areas. These findings, as well as those of Solomon and Howes,⁷ suggested that a more efficient explanation of the results of the studies dealing with accuracy of perception and value might be possible within the personal construct theory.¹⁰

Basic to the orientation of the personal construct theory is the notion of simultaneous generalization and differentiation in concept formation. Kelly states, "We cannot express a concept either explicitly or implicitly without involving at least two things which have a likeness and one which is, by the same token, different."¹⁰ An individual is seen as developing a series of personal concepts which are referred to as "constructs" rather than concepts because of the added assumption of simultaneous differentiation. The individual then uses this series of "personal constructs" in order to anticipate events. The addition of the differentiation aspect of construct formation means that the constructs which an individual develops and uses are dimensional in nature. One end of the dimension denotes likenesses and the other end refers to the events from which these likenesses differ. Thus it would not be surprising within the personal construct theory to find an individual giving words either similar in meaning or contrary in meaning to words presented tachistoscopically, particularly if the words being presented were similar to the words which outlined a personal construct dimension. Furthermore, it would not seem surprising to find certain words being recognized more readily than others since some of the words presented would bear a closer relationship to the particular individual's personal constructs than others. In addition, it seemed that both words connoting high value and low value (positive and negative value) would be responded to more quickly if they had personal relevance than either would be if they had not. Thus, an individual might quickly recognize the negatively valued end of a personally relevant dimension and very slowly recognize the positively valued end of an irrelevant dimension.

The dissertation is an attempt to demonstrate the manner in which personal relevance might affect recognition of words presented with limited time for perception. The order of emergence of the poles of a personal construct dimension when an individual is given an opportunity to invoke his concepts indirectly was also investigated as a determinant of the accuracy of his perception. It seemed likely that the pole of the dimension which is first invoked would be the one that is most clearly defined. For example, if a person used a construct of "social-antisocial" and "social" was the emergent pole of the dimension, it seemed likely that the behaviors relating to being "social" would be more clearly defined than the behaviors related to being "antisocial." That is, being emergent, it would be more readily invoked. Being more readily invoked would mean that more individuals would be described by "social." If more persons could be described by it, then perhaps the behaviors relating to being "social" would be more clearly defined. Thus the dissertation represents an attempt to establish a relationship between personal relevance and accuracy on the one hand and between emergence and accuracy on the other.

In order to test the assumptions, "group construct dimensions" were used. These group construct dimensions were chosen from terms used frequently by female undergraduates to describe associates who were liked and disliked. Frequent use of the group dimensions could then be

expected to mean that the individual found these dimensions personally relevant. Value of the poles of the dimensions was determined by the manner in which the poles of the dimensions were applied. The terms which were consistently applied to liked people were assumed to have positive value; those which were consistently applied to disliked people were assumed to be negative.

The dimensions were chosen through determining from the responses of 85 subjects what the antonyms of these words were. Four dimensions were chosen in such a manner that a group measure of the frequency of usage of the dimensions and emergence of the poles of the dimensions was assured.

Through the use of peer judges, words related in meaning to the eight poles of these four dimensions were determined. These words were matched so that the mean difficulty level and Thorndike-Lorge frequency would be equal for each of the eight groups of twenty-two words. The measure of difficulty used took into consideration only the percentage of the group of judges who indicated that they were sufficiently familiar with the words to assign them to one of our eight categories. Words were selected as being related if twice as many of the judges assigned a word to one category as assigned that same word to any other single category. At this point we had eight groups of words (four dimensions) of equal difficulty level and Thorndike-Lorge frequency.

The next step in the procedure was to obtain measures of the personal relevance of the dimensions, emergence of the poles of the dimensions, and accuracy of perception of the words related to these dimensions. A modified form of the Pole Construct Repertory Test described by Kelly¹⁰ was used to obtain the first two measures. However, instead of allowing the subjects to use their own personal constructs to describe and contrast the persons used in the sorting procedure provided for in the test, the 55 female undergraduates were required to use the "group construct dimensions" which had been selected from the general group of female undergraduates. The frequency with which the dimensions were used constitutes our measure of personal relevance. In applying the prescribed dimensions the subjects were required to "Note some way in which two of these people are alike and yet different from the third." The pole of the dimension which was used most frequently to describe the paired people is considered to be the emergent pole of that dimension and its opposite the implicit pole. Accuracy of perception of the dimension-related words was determined by presenting the words to subjects in such a manner that a minimum of time was allowed them to assign each word to one of the eight categories or the "don't know" column. An auditory presentation was used with only a single presentation of the word.

The hypotheses to be tested predict a positive relationship between frequency of usage and accuracy of assignment of the related words, and between emergence of the poles of the dimensions and assignment of the related words. Predictions were made at both the group and individual levels, at the group level by using the group measures of relevance and emergence assured in the selection of the dimensions, and at the individual level through the use of the modified form of the Pole Construct Repertory Test. The difference between the accuracy scores for the positively valued categories and the negatively valued categories of the four dimensions was determined to test

the prediction made by Postman, Bruner and McGinnies that positive value is related to accuracy and to compare this prediction with emergence as a predictor of accuracy. In the first group of subjects frequency of usage and emergence at the group level does not appear to be related to accuracy. At this level value appears to be more closely related to accuracy. The positively valued categories had significantly higher mean accuracy scores than the negatively valued categories, $t = 3.27$. This is significant beyond the .01 level of confidence.

At the individual level, with the individual measures of personal relevance and emergence, no relationship appears between personal relevance and accuracy. There is, however, a significant relationship between emergence and accuracy. The categories which are emergent have mean accuracy scores which are significantly higher than the mean accuracy scores for the implicit categories. The difference between these two means is significant beyond the .01 level of confidence.

The finding of a relationship between value and accuracy and between emergence and accuracy suggested that there was significant difference between the frequency of emergence of the positively and negatively valued poles of the four dimensions. This was tested using Chi square and a theoretical frequency which assumed equal emergence. The Chi square proved to be 485.68. An analysis of the frequency of application of the poles of each of the four dimensions indicated that the nature of the role titles used in the administration of the test might have led to the more frequent emergence of positively valued poles of the dimensions.

Replication of the study conducted with some change in methodology revealed essentially the same results. No relationship appeared between our measures of personal relevance and emergence at the group level, and a relationship was found between positive value and accuracy. The positively valued poles again proved to have significantly higher accuracy scores than the negatively valued poles of the four dimensions. Again the difference was significant beyond the .01 level of confidence.

At the individual level the most personally relevant dimensions had significantly higher accuracy scores than the dimensions which had the least personal relevance ($.01 > p < .05$). The emergent poles, as in the first group, had significantly higher mean accuracy scores than the implicit poles of the four dimensions. Again the positively valued categories proved to be more often emergent in spite of the fact that an equal number of liked and disliked persons were used in the Pole Titles of the Pole Construct Repertory Test. This difference was tested in the same manner as before. The resulting Chi square was 15.64, which is significant beyond the .01 level of confidence (df-1).

In an attempt to clarify the findings for accuracy and value, the accuracy scores were divided into four groups and the mean accuracy scores computed for the (1) the positively valued poles which were emergent; (2) the positively valued poles which were implicit; (3) the negatively valued categories which were emergent; and (4) the negatively valued categories which were implicit. The positively valued emergent categories proved to be significantly higher than any of the remaining three categories. Since there was no significant difference between the negative implicit and the negative emergent categories, it appears that emergence alone is not a predictor of accu-

racy of perception. Since the positive implicit category was not significantly higher than the negative implicit category, it appears that value alone is not a sufficient predictor of accuracy. Since both emergence and positive value coincide before a significant difference is obtained, frequency perhaps has a differential effect on positively valued categories rather than on negatively valued ones. It seems likely that this occurs because the dimensions which we have chosen are value dimensions.

If change in behavior of the members of this group is in the direction of the behaviors which are positively valued by the group, it might be expected that the positively valued behaviors would become increasingly clearly defined as the individual emergence of these positively valued categories increases. Until the individual construes the dimension which the group uses, clearer definition of either pole of the dimension is impossible. As the individual begins to think in terms of the dimension that the group uses, the behaviors relating to the positively valued pole of that dimension becomes increasingly well elaborated. This rationale is supported by the difference between the mean accuracy scores for the positive and negative categories being significant beyond the .05 level of confidence for the most frequently used dimension but not for the least frequently used dimension and the difference between the mean accuracy score for the emergent ends and the implicit ends of the most frequently used dimension being significant beyond the .05 level of confidence. This is not true of the least frequently used dimension. Thus it seems safe to assume that the dimensions which have the clearest definition are the dimensions which have the greatest personal relevance. It seems further that the positively valued ends of the personally relevant dimensions tend to become more frequently used and more clearly defined than the negative.

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PERSONAL VALUES AND VISUAL THRESHOLDS IN A COMPLEX RECOGNITION TASK

(L. C. Card No. Mic 59-2429)

William Russell MacDonald, Ph.D.
Boston University Graduate School, 1959

Major Professor: Murray L. Cohen

The purpose of the present experiment was to study the relationship between motivation and perception, specifically between visual recognition thresholds of words related to specific areas of personal value.

The context of this experiment is provided by those studies in perception which found evidence for a relationship between positive motivational states of the perceiver and the speed with which the perceiver recognizes motivationally congruent stimuli. Those studies utilizing personal value as the motivational factor have engendered much theoretical and methodological criticism. One such critique proposed to explain the obtained relationship between high personal value and low recognition thresholds for relevant high value words on the basis of the perceiver's familiarity with the stimulus words used. In that experiment the value factor was insignificant when common words were used.

It has been suggested that the level of difficulty of the task may be a factor in determining the extent to which motivational factors will operate in perception. The present study proposed that increasing the difficulty of the perceptual task will allow the effects of personal values on the speed of recognition of familiar words to become measurable.

It was postulated that the former method of presenting common words singly at a fixation point represented a level of difficulty, D1, at which recognition was primarily a function of non motivational factors. It was further postulated that a higher level of difficulty, D2, could be established by simultaneously presenting two common words located around a fixation point. It was further postulated that at level of difficulty D2 recognition would be a function of motivational as well as non motivational factors.

The prediction was made that familiar words related to a high value area would be recognized at shorter exposure times than simultaneously presented familiar words from a low value area. To test this prediction four pairs of words, each pair containing one word judged relevant to the social value area and the other to the economic value area, were used. Words in each pair were matched for high frequency of occurrence in popular literature, length, and ease of recognition.

The four word pairs were then presented along with four pairs (insert pairs) containing words from the four other areas represented in the Allport, Vernon, Lindzey Study of Values. Six cards were used for each word pair to control for positional effects.

A mirror-type tachistoscope was used to present the word pairs to 30 male advanced college students. On the basis of their scores on the Allport, Vernon, Lindzey scale these subjects were separated into three groups of ten subjects each. The first group was characterized by high social and low economic values; the second had high economic values and low social values; and the third group consisted of those who were average or low on both social and economic values.

The resulting data were analyzed by an analysis of variance producing an F value for the Groups by Value interaction which was significant at the .01 level. The analysis also yielded significant variations for word length and word type tending to corroborate the findings of previous experiments.

An attempt was made to explore the variation attributed to the difference between social and economic words. Suggestive evidence was found that the Economic Group is further classified in terms of their scores on both social and related values (religious and aesthetic), and that the Economic Subgroup which is low on this triad of values achieves thresholds more in accord with the prediction based on values.

The conclusion of the present experiment is that under conditions of a complex visual task high personal value leads to increased speed in the perception of value relevant stimuli. Microfilm \$2.00; Xerox \$4.80. 93 pages.

AN INVESTIGATION OF THE RESPONSE TO STRESS OF PATIENTS HOSPITALIZED FOR ANXIETY STATE AND PEPTIC ULCER PATIENTS

(L. C. Card No. Mic 59-871)

Martin E. Mendel, Ph.D.
University of Southern California, 1958

Chairman: Professor A. Jacobs

Manifest, free-floating anxiety has been associated in the literature with chronically heightened sympathetic autonomic activity. Peptic ulcer has been regarded as a psychosomatic disorder associated with chronically heightened parasympathetic autonomic activity. The present study directed itself to the question whether patients hospitalized for these two conditions react to stress in a manner different from normal persons. In order to investigate such possible differences in the response to stress, 32 subjects hospitalized for emotional disorders with prominent anxiety symptoms and 34 subjects hospitalized for peptic ulcer were compared with 30 subjects hospitalized for nonpsychiatric disorders.

The subjects were subjected to a psychological stress and were compared on two measures of cardiovascular autonomic activity (heart period and systolic blood pressure) and two questionnaire measures (an anxiety self-rating and a question concerning what they had anticipated).

It was predicted that both the anxious and ulcer group would fail to react to the stress to the same degree as the normal control subjects on the cardiovascular measures. The anxious group, it was postulated, was already so mobilized toward stress that added arousal would be difficult for them. This could be tested by first comparing their

resting level to that of normal subjects and then comparing the magnitude of their response to the stress with that of the normal subjects. Significantly higher base levels were found to obtain for the anxious subjects. However, no significant differences were found in initial stress response, though a consistent tendency toward a smaller response increment than among the normal subjects was found.

It was also predicted that anxious subjects would more readily admit to feeling anxious than normal subjects and ulcer patient subjects, both initially and after the stress. While their initial verbal report was found to be one of reported greater tension than that of the other two groups, they did not report as great an increment of felt tension as the normal subjects, but the increment was higher than that of the ulcer group, as predicted. A negative correlation between heart rate and the verbal measure indicated a tendency for low physiological reaction to be associated with high verbal reaction for the anxious subjects and high physiological reaction to be associated with low verbal report. This finding was interpreted in the framework of excessive sensitization to anxiety.

By way of contrast to the anxious group, the ulcer subjects started, on the cardiovascular measures, at a base level similar to the normal group. Their stress response was significantly lower than that of the other two groups. A mechanism of repression was hypothesized to be operative if low autonomic response concurred with low verbal response. This hypothesis was confirmed by the findings on the ulcer group, as well as by a significant positive correlation between heart rate and verbal report.

The remainder of the study dealt with poststress recovery patterns under conditions of rest and of "catharsis." Predictions that the anxious group would recover more slowly than the normal group were not confirmed by the data, though the anxious group responded with a greater degree of recovery to base level than the ulcer group under the catharsis condition. The ulcer group's recovery curve was unlike that of both the normal and the anxious group. Their initial tendency to fail to respond to stress was followed by considerable reactivity, particularly in the catharsis condition. It was suggested that the findings for this group were comparable to findings in the literature relating to physiological expression of anger as contrasted with anxiety. Implications for future research were discussed in the light of the present findings.

Microfilm \$2.00; Xerox \$6.20. 129 pages.

**AN OBJECTIVE APPROACH TO A BEHAVIORAL
CLASSIFICATION OF JUVENILE DELINQUENTS
AND ITS RELATIONSHIP TO
TREATMENT ASSIGNMENT**

(L. C. Card No. Mic 59-2205)

Paul Frederick Charles Mueller, Ph.D.
University of Washington, 1959

Chairman: Charles R. Strother

Ratings on six behavioral scales--Aggression-Non-aggression, Maladaptive Dominance-Adaptive Submission, Rejection-Acceptance Conformity Code, Acceptance-Re-

jection Gang Code, Desurgency-Surgency, Withdrawal-Participation with People--were made by independent pairs of raters from the case history information of 204 delinquent boys, who had been assigned from a diagnostic center to parole, forest camp, and training school. Selected ratings on Aggression and Maladaptive Dominance dimensions were summed to give a measure of personal controls while all ratings were subjected to two methods of configural analysis, DuToit's and Gengerelli-Butler's for typological classification into Accidental, Emotionally Disturbed, Socialized and Unsocialized Aggressive Delinquents. Objectivity of classifications was secured through pre-test selection of behavioral dimensions, definitions of terms, training of raters, and prescribed mathematical manipulations to arrive at delinquent type and sub-type classifications. Reliabilities of components were tested through indices of the degree of inter-rater agreement. All classificatory components were tested for validity by determining their association with the degree of security of treatment assignments and their differential relationships to success or failure within or between treatment assignments. Personal controls levels were additionally tested for their predictive validity for disciplinary notices at the training school.

The primary goal of developing an objective and reliable behavioral classification system for juvenile delinquents was accomplished. All classificatory components of the system had an acceptable degree of inter-rater agreement. There was also a high degree of inter-method agreement between the two similar methods of typological classification. The secondary goal of determining the validity of the classificatory components revealed that: (a) almost all the components were associated as expected with the security of treatment assignments; (b) personal controls levels had poor predictive validity for disciplinary notices; and (c) only components indicating conforming or neurotic tendencies had predictive prognostic validity. Most delinquent type or subtype classifications could not be tested for prognostic ability because of sample fractionation. The classification system could be used to classify reliably and to describe treatment groups objectively but had practically no prognostic value.

Microfilm \$2.20; Xerox \$7.60. 165 pages.

**LOGICAL REASONING IN SCHIZOPHRENIA—
THE VON DOMARUS PRINCIPLE**

(L. C. Card No. Mic 59-1857)

Jerry Pat Nims, Ph.D.
University of Southern California, 1959

Chairman: Professor A. Jacobs

* Von Domarus and Arieti describe the essential characteristic of schizophrenic disorder as being a propensity to conclude that a relationship exists between any two objects which contain some common characteristic. Phrased in the language of formal logic, the statement is that schizophrenics utilize the fallacy of the undistributed middle in drawing invalid conclusions. Normals supposedly accept only logically valid conclusions.

In addition to their statements about this formal aspect

of the thought disorder, Von Domarus and Arieti concur with other writers who have observed that schizophrenics are less able to reason or respond accurately when confronted with emotional or conflict-laden material than when they are presented with neutral material.

Two hypotheses were drawn from the preceding background of experimental and clinical literature: (1) schizophrenics would make proportionately more errors of fallacies of the undistributed middle than would nonschizophrenics in solving syllogisms, and (2) schizophrenics would demonstrate proportionately more errors of logic in solving emotional as compared with neutral syllogisms than would nonschizophrenics.

Twenty-five schizophrenics and twenty-five nonschizophrenics were matched for verbal intelligence and approximately matched for age and education. The schizophrenics were patients from the acute intensive treatment service of a metropolitan Veterans Administration neuropsychiatric hospital. The nonschizophrenics were patients from a nearby hospital, also Veterans Administration, for the treatment of tuberculosis. None of the subjects had had training in logic or philosophy.

The subjects were given an especially designed test containing approximately equal numbers of valid and invalid syllogisms. The invalid syllogisms consisted not only of those in which the undistributed middle appeared but also those containing two other fallacies. Within each of the four classifications half of the syllogisms involved emotional material and half involved neutral material. The test was found to have a split-half reliability of about .88.

The data were treated by a complex analysis of variance to determine if there were any interactions between the experimental variable—schizophrenic vs. nonschizophrenic—and the dependent variable, the ability to judge correctly the validity of syllogisms. The various classifications of logic and the emotional and neutral content were the different conditions under which the dependent variable was measured.

Results. Neither of the experimental hypotheses received support. Not only did schizophrenics fail to demonstrate a propensity for any particular fallacy, they failed to demonstrate any significantly lower ability on the test as a whole. Items at the more difficult levels of the test did, however, discriminate between the two groups. Thus, support was found for the contention that schizophrenics are less accurate in their use of logical rules than are nonschizophrenics.

It was also found that there was a high correlation between the subjects' attitudes toward the conclusions of the syllogisms and their judgments as to the validity of the syllogisms. The tendency was for subjects to judge invalid those syllogisms wherein they agreed with the conclusion.

Microfilm \$2.00; Xerox \$4.80. 95 pages.

AN INVESTIGATION OF THE CONTENT OF THE RORSCHACH HUMAN MOVEMENT RESPONSE UTILIZING THE SUBJECTS' ASSOCIATIONS TO THEIR OWN M

(L. C. Card No. Mic 59-2451)

Rolland S. Parker, Ph.D.
New York University, 1959

Adviser: Dr. Zygmunt A. Piotrowski

This investigation of M explores certain hypotheses concerning overt expression, degree of acceptability of associated attitudes, and the identification of the perceived figure. Data was derived from the Ss' attitudes expressed towards their own percepts. Rorschach stated that the M-type was characterized by introversion, and stability in affect and motility. In the case-history appended to the *Psychodiagnostics* he ascribed M to unconscious attitudes. Piotrowski asserted that M reveals the relationship between the perceiver and reality, that associated attitudes would be expressed overtly if social conditions permit, and the more that M resembled its perceiver, the greater the likelihood of its expression.

THE METHOD

A questionnaire directed towards the S's M included items referring to the age, sex and race of the perceived figure, and the S's attitudes towards: The activity; the perceived figure; any autobiographical figure associated to M; and discussion of his M. The S also: Rated his degree of similarity to the M; identified the figure; rated the activity for acceptability; stated whether he had performed the activity, and whether performing it would elicit anxiety. A pattern of Expression-Suppression scores was derived from 4 items concerning Acceptability, Similarity, Action-tendency, and Communication. Each percept was rated on a scale of Flexion-Extension. The Rorschach was individually administered, and one M was sampled from each of the 30 male college students, and 60 Hospitalized Schizophrenics.

THE FINDINGS

A. EXPRESSION: 19/30 Students and 30/60 Schizophrenics gave Expressive response-patterns. The Expression-Suppression score was independent of: The age, sex and race of the figure relative to S; the acceptability of the Activity; and, certain Rorschach and autobiographical variables. About half of both groups stated that they had either performed the activity or had thought of doing so.

B. ACCEPTABILITY: 73% of the Students and 83% of the Schizophrenics gave favorable ratings to the perceived activity, and a large majority indicated that performing it would not create anxiety. Acceptability was not associated with perceived Age, Sex, or Race and decreased when Ss were required to increase their identification with the M. The Students were prone to associate Acceptable ratings with the Self, and the Schizophrenics to dissociate Acceptable ratings from the Self. In both groups Unacceptable ratings were associated with Not Self, and the modal rating was Acceptable-Dissimilar to the Self.

C. IDENTIFICATION: Figures of the opposite or undetermined sex were perceived by 73% of the Students and 58% of the Schizophrenics, and of a different or undetermined race by 73% of the Students and 63% of the Schizophrenics. Since M was rated as Dissimilar by 63% of the Students and 87% of the Schizophrenics, this reversal of identification suggests that each group used different criteria. A significant proportion of both groups attributed M to the environment rather than to internal dynamics such as wishes or fears. The Flexion-Extension Score was not associated with Expression-Suppression scores but did differentiate between Students and Male Schizophrenics.

CONCLUSIONS

The fact that half or more of the M elicited Expressive response patterns is consistent with Piotrowski's hypothesis that the S tends to express the drives represented by M, and casts doubt upon Rorschach's assertion that M is a derivative of the unconscious. Since there was no evidence of either displacement or expression according to the variables of perceived Age, Sex or Race of the figure relative to S, it is necessary to distinguish between the ACTIVITY and the ACTOR carrying it out. The response-pattern did not suggest that M is a derivative of unconscious fantasies.

Microfilm \$2.75; Xerox \$9.60. 212 pages.

THE INTELLIGENCE, SOCIAL MATURITY, PERSONAL ADJUSTMENT, PHYSICAL DEVELOPMENT, AND PARENT-CHILD RELATIONSHIPS OF CHILDREN WITH CONGENITAL HEART DISEASE

(L. C. Card No. Mic 59-2368)

Murray King Reed, Ph.D.
University of Minnesota, 1959

Very little psychological research has been done on children with congenital heart defects. Only through recent medical advances has it been possible to identify accurately and at an early age a sizable group of these cases. Congenital heart disease as a physical handicap is psychologically interesting because, although often seriously disabling and always a potential threat to life, it is invisible and lacks social stigma.

This study examined aspects of the intelligence, social maturity, personal adjustment, manipulative skill, height and weight, and maternal attitudes experienced by young children with congenital heart disease. Previous literature has suggested that the foregoing factors may be unfavorably associated with congenital heart disease in children.

Clinical subjects for this study were 23 boys (mean age: 54 months) and 27 girls (mean age: 63 months), ages 3 to 8 years, diagnosed as having congenital heart disease, and randomly selected from an out-patient, cardiac clinic. Each clinical subject was closely matched with a non-disabled child on age, sex, socio-economic status, and number of siblings. Control cases were selected from the total populations (no volunteers) of three, large, day care nurseries.

Data gathered on each child included: Binet IQ, Seguin Form Board time, a clinical judgement of personal adjustment, Vineland Social Maturity Scale SQ, height, weight, and results of a medical history and physical examination. A pediatrician rated each Clinical subject on the severity of his cardiac defect. The mother of each subject completed a Parent Attitude Research Instrument (PARI) and provided opinions about her child's adjustment.

Clinical and Control samples were compared on all of the above data. Within the Clinical group, older subjects were compared with younger and milder cases with more severe on several types of data. Results showed no significant differences between samples in IQ, SQ, or ratings of adjustment. Sample means of IQ and SQ were close to normative values. Within the Clinical group, a severe cardiac defect was compatible with a high IQ and with a high SQ. A high SQ could be earned by any but the most acutely ill patients, of whom there were few in the sample. Within the range of disability studied, neither IQ nor SQ were significantly related to severity of handicap. Subjective impressions regarding personal adjustment suggested that Clinical subjects had greater social anxiety and perceptiveness and more eagerness to please the examiner. Control children appeared more relaxed but less responsive to social-interaction cues.

Clinical subjects were significantly slower and more variable on the Seguin. The meaning of this result was not clear but the finding tends to corroborate an earlier study. Seguin scores of the Clinical group were not related to severity of handicap.

The PARI produced no significant differences between mothers of boys but mothers of Clinical girls did have significantly higher scores on pathogenic scales labeled, "Intrusiveness" and "Fostering Dependency." The latter includes attitudes often ascribed to mothers of the handicapped but the former scale's content has not often been discussed in the relevant literature. Most Clinical Mothers appeared to have made a fairly realistic adjustment and to have made very good use of the kind of medical counsel offered at the clinic. This counsel was brief but practical, easy to understand, factual, and warm. Almost all parents were advised to let the child set his own pace of activities.

Control children tended to be taller and heavier than Clinical children but the differences were significant only for girls. Control as well as Clinical boys were below normative values for height and weight. About 70% of both Clinical and Control groups were described by pediatricians as well developed and well nourished.

Microfilm \$2.20; Xerox \$7.80. 168 pages.

THE SELF-CONCEPT IN ADOLESCENT GIRLS

(L. C. Card No. Mic 59-2431)

Catherine Roff, Ph.D.
Boston University Graduate School, 1959

Major Professor: Murray L. Cohen

The purpose of this study was to investigate two dimensions of the self-concept of girls in successive phases of the developmental process. One dimension was self-satisfaction, that is, the degree to which the girl is content with herself. The second dimension was identification with

mother, that is, the connection between the girl's self-picture and her image of the major identification figure available to her, her mother. The hypotheses investigated related to the expected fluctuations in self-satisfaction and identification with mother in prepuberty, early puberty, and late puberty. They were based on certain theories about the characteristics of these periods.

Prepuberty is a period during which the girl experiences relatively little acute internal tension, and her dependence on her parents is still accepted by herself and them. In early puberty, however, physical maturation is well under way and the girl is confused by the upsurge of internal drives. At the same time that she strives for independence, she also fears it. She tries to be different from her mother but is still closely identified with her. By late puberty more adequate ways of coping with the internal drives have been developed and independence has become less frightening. While it is no longer so threatening to be like mother, identification with other persons from a wider world of experience has reshaped important aspects of the girl's ego-ideal.

On the basis of these theoretical considerations, the following hypotheses were generated:

1. In the course of female development, there will be a decline in self-satisfaction from prepuberty to early puberty and a rise in late puberty.
2. In the course of female development, there will be a decline in self-mother identification from prepuberty to early puberty and a rise in late puberty.
3. In the course of female development, there will be no marked difference in ideal-mother identification in prepuberty and early puberty, but there will be a decline in late puberty.

A Q-sort technique was employed to test these hypotheses. Descriptive statements were sorted three times to reflect the self image, the ideal image, and the image of mother respectively. Correlations between the sorts served as measures of self-satisfaction, self-mother identification, and ideal-mother identification. To represent the developmental periods, three groups of girls, whose ages were 11, 14, and 17 years, were originally included, and a fourth group of 20 year old girls was added in the course of the study.

The results based on the data from the original three groups did not support the hypotheses. Responses of the 17 year old group, however, approximated those predicted for 14 year olds. On the premise that adolescence extends for a longer period than originally postulated, a transposition of the developmental hypotheses was tested by the addition of a 20 year old group.

The findings from the extended study in general supported the hypotheses except for a conspicuous departure from the prediction regarding self-mother identification.

Self-satisfaction declines continuously through the adolescent period until the end of adolescence when it rises slightly. This suggests that the self-concept is most severely shaken in later adolescence, defined as age 17, and that its reintegration has only begun at the end of adolescence, defined as age 20.

Self-mother identification declines continuously through the entire adolescent period, reaching its lowest point at the end of the adolescent period. This result is contrary to the prediction. Ideal-mother identification remains

high until the end of adolescence when it declines sharply. Thus, it would appear that overall identification with mother is not significantly loosened until the end of adolescence. The patterns of the fluctuation of the two measures of identification are quite different and give rise to various interpretations of adolescence.

Microfilm \$2.00; Xerox \$5.80. 116 pages.

POST-PROBATION ADJUSTMENT OF 200 OFFICIAL CASES OF JUVENILE DELINQUENCY IN PHILADELPHIA

(L. C. Card No. Mic 59-2344)

Leonard Rosengarten, Ed.D.
Temple University, 1959

The inadequacy of statistics and research in crime and corrections has been pointed out frequently by qualified authorities. Nowhere is this more apparent than in the absence of studies evaluating the effectiveness of probation. The study presented here is an attempt to evaluate the effectiveness of probation as a correctional device by determining what proportion of two hundred juveniles discharged from probation as "satisfactory" by the Municipal Court of Philadelphia remained law-abiding. It seeks to determine the nature of the variables which are associated with subsequent lawful or unlawful behavior.

Discharge from probation as "satisfactory" denotes that the probation period is terminated with the return of the probationer to normal community life without further court supervision. It implies that henceforth he will remain a law-abiding citizen.

The subjects involved were two hundred male juveniles officially adjudged delinquent and placed on probation by the Municipal Court of Philadelphia whose probation periods terminated satisfactorily during 1950.

Eighty-seven of the subjects were Negro and one hundred and thirteen were white. Their ages at the time of discharge ranged from nine years to eighteen years, six months. Their age at time of being placed on probation ranged from eight years, two months to sixteen years, four months. The length of time spent on probation ranged from four months and twenty days to one hundred and forty-four months and twenty-seven days. The average probation period was about fifteen and one-half months.

The subjects were chosen by random selection from a total group of three hundred and eighty-one male juveniles discharged from delinquent probation during 1950 by the Juvenile Division of the Municipal Court.

The subjects who were adjudged delinquent or convicted of a criminal offense during the five year period from their discharge in 1950 to December 31, 1955, were placed in the "failure" group. Those who remained law-abiding during this period were placed in the "success" group. The two groups were then compared to determine how they differed in terms of factors presumably related to success and failure. The source material of this study came primarily from court and police records. The main source of the data used was the individual case records of the Juvenile Division of the Municipal Court.

Court records revealed that 32.5 per cent of the 200 subjects who were discharged from probation as "satisfactory"

in 1950, were subsequently convicted of a more or less serious offense, such conviction occurring during the five-year follow-up period ending December 31, 1955.

There was little difference in the type of probation service rendered the success and failure groups in terms of frequency of contact between officer and probationer, special aids or services offered the probationer or length of probation period.

A group of variables that appears to be the most closely related to post-probation success or failure are those centering about the delinquent pattern of the individual and his family. Included in this group are: arrests prior to offense leading to probation; age at first arrest; age placed on probation; type of offense; total arrests; other siblings known to court; other siblings adjudged delinquent; other siblings committed to institutions.

A second group of variables which centers about the family and home conditions also seems to be indicative of post-probation success or failure.

These variables can be readily located in the case record by the working probation officer. They may serve as guides in aiding him to locate the cases which are in need of his special efforts, so that the probation service can operate with maximum return.

Microfilm \$2.00; Xerox \$6.40. 134 pages.

DIFFERENTIAL RESPONSES OF YOUNG ADOLESCENTS TO FOUR MEASURES OF MASCULINITY-FEMININITY AND THE RELATIONSHIP BETWEEN TEST SCORES

(L. C. Card No. Mic 59-2459)

Aaron J. Weiss, Ph.D.
New York University, 1959

Adviser: Dr. David Wechsler

The object of this investigation was to study the differential responses of young adolescents to four measures of M-F and the relationship between the test scores.

After the theoretical and empirical backgrounds of M-F testing were reviewed, the logical and empirical validity for the concepts of sexual identification and adjustment capacity as explanatory principles for M-F test reaction were discussed and contrasted. Five hypotheses were stated:

I. The Work Interest Inventory, Geometric Designs, Sex-Role Associated Nouns, and Draw-A-Person tests would significantly differentiate the experimental sex groups.

II. Scores on the four experimental tests would correlate positively.

III. Scores on the significantly differentiating M-F tests of this study would correlate positively with scores for adjustive capacity as derived as a sum of judges' ratings of the human figure drawings.

IV. There would be a significant difference between the composite scores for the significantly differentiating M-F tests of this study for members of a sex group who drew opposite-sex and those who drew same-sex figures on the DAP test.

V. There would be a significant difference between the

adjustment scores derived from the DAP for the deviate high and low score groups defined by their respective high and low composite scores for the significantly differentiating M-F tests of this study.

The Wechsler Work Interest Inventory form, the DAP test, and two tests developed by the investigator--the Geometric Designs and Sex-Role Associated Nouns tests--were the experimental tests.

The experimental population consisted of 78 non-psychiatric males (mean age, 13 years and 2 months) and 93 non-psychiatric females (mean age, 13 years and 2 months), in the sixth through the tenth grades, of the Jewish faith, and coming from a lower- to upper-middle class socioeconomic background. They were tested in small groups of eight to twelve in their classrooms in New Haven, Connecticut, and South Orange, New Jersey.

Results and Conclusions.

I. The WII, SRAN, and DAP significantly differentiated the experimental sex groups (at over .001 level). The GD test did not differentiate the sex groups.

II. For the total group, the test scores manifested a high positive relationship. For the sex groups separately, this relationship was low and insignificant.

III. Scores on the WII, SRAN and DAP, the significantly differentiating tests of this study, exhibited low and insignificant relationship with scores for adjustment capacity as derived from the DAP test.

IV. No significant difference in scores on the WII-SRAN tests was exhibited between opposite-sex and same-sex drawing groups of each sex group.

V. No significant difference in adjustment scores, as derived from the DAP test, was exhibited between deviate high and low score groups (in each sex group) defined by their composite score for the WII-SRAN tests.

The experimental results were discussed in light of the theoretical background and previous relevant M-F study findings. Theoretical and clinical implications were stated and discussed and several specific research problems for future investigation were delineated.

Microfilm \$2.20; Xerox \$7.80. 168 pages.

PSYCHOLOGY, EXPERIMENTAL

DIFFERENTIAL RESPONSE AS A FUNCTION OF REDUCED AND NON-REDUCED (IRRELEVANT) DRIVES

(L. C. Card No. Mic 59-2347)

James Huber Banks, Jr., Ph.D.
University of Minnesota, 1959

Adviser: Kenneth MacCorquodale

In this experiment an attempt was made to establish a spatial discrimination between a combined drive of hunger-thirst and hunger, when only the hunger drive was ever reduced (Group Ht-H), and between a combined drive of thirst-hunger and thirst, when only the thirst drive was ever reduced (Group Th-T).

The rats did not learn the discrimination but their behavior was highly systematic. In Group Ht-H, under hunger-thirst the rats made 59% correct responses and under hunger 47% correct responses. In Group Th-T, under thirst-hunger the animals made 35% correct responses and under thirst 71% correct responses. Thus, not only were there significant differences between conditions in each group but also the direction of the difference was opposite for the two groups.

The possibility that these results could be explained on the basis of strength of drive, biased response tendencies, or differences in satiation in the two groups was examined and rejected.

The data can be explained as a position preference for the side appropriate to the condition containing the clearest thirst element. They can also be completely and in detail derived from Corollary XVI of Hull's 1952 system if it is assumed that hunger generalizes over a wider range of stimulus intensity values than thirst.

A secondary conclusion could be that it is difficult to predict behavior under combined drives from knowledge of behavior under the single drives and that more "theoretically neutral" research must be done if results obtained using hunger and thirst are to be meaningful.

Microfilm \$2.00; Xerox \$4.00. 74 pages.

AN INFORMATIONAL APPROACH TO PROBLEM SOLVING AND THINKING BEHAVIOR

(L. C. Card No. Mic 59-2233)

John Gaito, Ph.D.

University of Pennsylvania, 1959

Supervisor: Dr. R. H. Forgas

This research represents an attempt to investigate the utility of a modified informational model for problem solving behavior. Four descriptive principles are offered which form the basis of a working model for investigating this type of behavior. It is hypothesized that problem solving behavior is a function of organismic set, stimulus set, and the requirements of the task; and an experiment concerning these three variables is reported. Both organismic set (ability to extract information from a stimulus situation) and task requirements produced significant effects on the performance of 47 subjects on numerical, arithmetical, and abstract reasoning items taken from standardized psychological tests, but stimulus set (training emphasizing one or five modes of response) did not. By correlational analysis the organismic set dimension was indicated to consist of intelligence and at least one other factor, which was called flexibility. The utility of the informational model for studying problem solving behavior and for other areas is discussed.

Microfilm \$2.00; Xerox \$3.60. 62 pages.

A COMPARISON OF SOME ANALYTIC METHODS OF ROTATION IN FACTOR ANALYSIS

(L. C. Card No. Mic 59-2201)

Edward Francis Gocka, Ph.D.

University of Washington, 1959

Chairman: Paul A. Horst

At present, the very difficult part of multiple factor analysis concerns the problem of rotation. The original procedures for rotating the factor matrix to the criteria of simple structure were graphical methods involving subjective decisions, but in the past twenty years many investigators have proposed analytic solutions to this problem. This study was restricted to a comparison of three analytic methods of rotation which were regarded as representative of the current major trends. These methods were the quartimax method of Neuhaus and Wrigley, Horst's analytic iterative rotation using a varimax criterion (AIR-V), and the writer's modification of Thurstone's analytic procedure (MTAP).

Seven unique types of attribute configurations were used for the empirical evaluation of the selected analytic methods. Each attribute configuration was expected to present an individual challenge to each analytic method. Batteries of well known factor matrices with known simple structures were selected to represent the seven unique configurations. These seven attribute configurations were chosen after considering the symmetry or asymmetry of the total configuration, the balance or unbalance between the number of attributes clustered at the hyperplane intersections, and the number of attributes clustered along the hyperplanes between the axes.

The results from the analytic rotations were compared with those obtained from the subjective-graphical method. Four procedures were used to compare the similarity of the factor loadings produced by the three analytic methods with those of the graphical standard. The first procedure involved comparing the analytic rotations of the selected factor matrices with the well defined subjective-graphical values for each matrix. The second procedure involved the analytic rotation of factor matrices already in graphical simple structure form; here the resultant transformation matrix was evaluated in terms of its correspondence to an identity matrix. A third procedure compared the analytic results in terms of the metric and/or factor pattern invariance for subsets of larger matrices; here the metric invariance shown by the graphical method was the standard. The fourth procedure for making comparisons among the analytic methods necessitated the use of an independent analytic criterion value that could be applied to a rotated matrix; again the standard independent criterion value was the value obtained from the subjective-graphical simple structure matrix. This comparison was made on only one matrix.

The results of this investigation clearly indicated the relative adequacy of the three analytic methods of rotation when these were compared in various ways with the subjective-graphical standard. In general, the MTAP method reproduced the standard most successfully and the quartimax method reproduced it least successfully. The adequacy of the MTAP method was found to depend heavily on the trial attribute vector selections. As a result the method was less successful on data which had no

attribute vector close to the primary axes and was most successful on data where at least one attribute vector was near each primary axis.

The AIR-V method was successful only on the most "optimal" data matrices. On less "optimal" data the method tended to produce a general factor and to give many large negative values where a positive value was indicated by the standard. Since transformation to an arbitrary positive manifold improved the AIR-V results to some degree, it was recommended that all data treated by the AIR-V method be transformed to a positive manifold.

The quartimax method gave the poorest correspondence with the subjective-graphical standards, did not show sub-battery invariance, and failed completely on a larger data matrix. This method was not recommended for further investigation or use.

Microfilm \$2.30; Xerox \$8.00. 174 pages.

RESPONSE ELIMINATION AS A FUNCTION OF GENERALIZATION, MOTIVATION AND NUMBER OF NON-RESPONSE EXTINCTION TRIALS

(L. C. Card No. Mic 59-947)

Stanley Stewart Pliskoff, Ph.D.
New York University, 1956

Adviser: Professor Robert E. Silverman

Starting with an anticipatory-response theory of T-maze behavior, three predictions were made concerning the elimination of a turning response by means of an extinction procedure not involving the performance of the response in question. With this procedure, the Ss, after the acquisition of a T-maze turning response, are placed in the previously correct (i.e., previously food-laden, but now empty) goal-box; following non-response extinction (as the procedure has been termed), the residual strength of the turning response is estimated by counting the number of turns to the previously correct side of the T-maze in a standard block of test (extinction) trials.

Briefly, the predictions were: (1) there will be a smaller number of correct turns during the test series if non-response extinction is given under conditions of high drive than if non-response extinction is given under conditions of low drive, (2) the greater the number of non-response extinction trials, the smaller the number of correct turns during the test series, and (3) if the non-response extinction trials are given in a goal-box differing from the original, there will be a greater number of correct choices during the test series than if the non-response extinction trials are given in the original goal-box.

Prediction 1 was tested in Experiment I, and Predictions 2 and 3 were tested in Experiment II. The apparatus employed in both experiments consisted of a T-maze in which a black alley led to a black goal-box and a white alley led to a white goal-box. In Experiment I, albino rats were trained in the performance of a T-maze turning response under 7.5 to 8.5 hours of food deprivation, and non-response extinction (four 30-sec. trials) was administered under zero, eight, or 22 hours of food deprivation. The test trials, run under the acquisition conditions, indicated that the zero- and 22-hr. groups behaved differently, in accord with expectations, in terms of the number

of animals choosing correctly on the first test trial. It was concluded that the results were suggestive of a relationship between drive level and amount of non-response extinction.

In Experiment II, albino rats were trained in the performance of a T-maze turning response and given non-response extinction (one, four, or 20 30-sec. trials) in the "Same", a Gray, or the "Different" goal-box. It was necessary to analyze the data with the omission of the intermediate condition of either variable. The analyses indicated that the number of non-response extinction trials had affected the strength of the turning response as predicted, and, in addition, that the "Same-Different" variable had affected the strength of the turning response only if the number of non-response extinction trials had been large (20).

The results of the two experiments were briefly evaluated in terms of the learning theories of Tolman, Skinner, and Guthrie. Microfilm \$2.00; Xerox \$6.00. 125 pages.

A STUDY OF THE EFFECTS OF AUDITORY DISTRACTIONS UPON LEARNING

(L. C. Card No. Mic 59-1729)

Orrion Mayburn Schlichter, Ed.D.
The University of Florida, 1959

Statement of Problem

The increased use of techniques of group participation in the classroom, the increasing use of audio-visual instructional aids, as well as other noise and confusion producing activities, all combine to provide a problem of sound control in our schools of today. The purpose of this study was to test experimentally the hypothesis that auditory distractions exert an influence upon academic achievement. Concomitant problems treated in this study, also based upon this hypothesis included:

1. Whether the effect of distraction upon learning is one of facilitation or hindrance.
2. The degree of influence exerted by auditory distractions upon learning.
3. The relationship between mental ability and degree of distraction.
4. Whether there is any relationship between socio-economic status and degree of distraction.
5. Comparison of subject reports of students involved in the experiment with objective data obtained through the study.

Procedure

A random sample of one hundred twenty-one students was obtained from a population of five hundred fifty-four sophomores entering a large urban high school. Only those students registering for biology for the first time were included in the sample. Those students selected were distributed between five sections of biology in a random manner. All students included in the sample were then administered an intelligence test and the Cooperative Biology Test, Form X. Two sections were designated as control, while three sections were designated as experimental. All sections then underwent a four-day period of

instruction and classroom study over the material covered by the test. The control group had normal classroom atmosphere, while the experimental group underwent the same instruction and study procedure with the exception that during their class-time there was being played just outside of the room a series of tape-recorded sounds that were common to schools. These sounds were of high enough intensity to permeate the entire classroom. At the end of the four-day period, the biology test was readministered, with difference in score between test and retest being taken as a measure of academic achievement. This procedure was then repeated, using a teacher-constructed biology test with the control group for the first section of the study becoming the experimental group and the first experimental group becoming the control group for this second section of the study. The next following school day all students involved in the study completed a questionnaire designed to obtain their reaction to the experiment, their opinion regarding the effects of noise on their school work, their study habits and other data pertinent to this study.

Results

The results as tabulated were generally not statistically significant enough to prove the hypothesis upon which the study was based. There was a tendency for the evidence to support the hypothesis however.

Conclusions

Auditory distractions may have an effect upon academic achievement, as defined by the study, and this effect, for short periods of time is one of facilitation. There was a tendency for the evidence of this study to show that the more intelligent students, as measured by the instrument used in this study were less disturbed by auditory stimulation than were the less able students. The comparisons between various socio-economic groups produced no clear-cut pattern or trends in regards to the effects of auditory distractions upon academic achievement. The subjective reports of the students and of the instructor tended to support the objective findings of the study.

Microfilm \$2.00; Xerox \$4.60. 87 pages.

COMPARISON OF THE EFFECTS OF AN AUDITORY AND TACTUAL WARNING STIMULUS PRESENTED DURING COMPENSATORY TRACKING

(L. C. Card No. Mic 59-1833)

Shaffer Truax, Ph.D.
Rutgers University, 1959

Major Professor: William F. Reynolds

The purpose of the experiment was to investigate the use of a tactual stimulus in comparison with an auditory

stimulus as a warning signal. Using principles from man-machine, information, and engineering-psychology theory, a compensatory tracking apparatus was constructed. Attempt was made to simulate the decision making and performance tasks required of a pilot of a high speed craft. In the experimental design the frequency of presentation of the warning stimulus was varied as well as the pacing conditions.

Eight pretest Ss were run to determine the forced paced schedule, and forty experimental Ss were divided into four experimental treatments. All Ss performed the same compensatory tracking task, and all Ss received the warning stimulus in the same order. There were eighteen practice and learning trials with six warnings, followed by thirty-six trials with three warnings, followed by thirty-six trials with nine warnings. The four treatment groups were: auditory warning stimulus under self paced conditions, auditory stimulus under forced paced, tactual warning stimulus under self paced conditions, and tactual stimulus under forced paced. Measures of total reaction time per trial, reaction time to warning stimulus alone, and accuracy of compensatory tracking task were taken.

The results indicated that practice and learning continued after practice trials; therefore, the frequency effect could not be statistically tested. The experimental design was modified to collapse the frequency factor and a 2 x 2 analysis of variance and individual F tests for cells were computed.

While there was no significant treatment effect, the average percent error for accuracy was 6% and in all treatments the Ss made the adjustments of the oscilloscope circles smaller than the display circles. The average absolute error was 0.05 inches smaller.

No differences were found between treatments using reaction time to warning stimulus scores. The tactual stimulus was as effective as the auditory under all conditions.

Total reaction time scores, operationally defined as the time required to react to a warning stimulus and to perform a tracking task, were taken. Also analyzed were corrected reaction time scores where performance time was reduced by a constant and types of performance tasks were equalized. The results from both measures clearly showed that the tactual stimulus was as effective as the auditory under forced paced conditions, and significantly superior to the auditory under self paced conditions.

It was proposed that since the pilot of a high speed craft will be occupied by visual and auditory decision making and performance tasks, another sense modality be employed for use in reacting to a warning signal for mechanical breakdown. Since a tactual stimulus in this experiment was fully as effective as an auditory, and in certain cases superior, the use of a tactual warning system employing the tactual sense modality was suggested.

Microfilm \$2.00; Xerox \$5.20. 104 pages.

RELIGION

THE ATTITUDE OF AMERICAN JEWISH LEADERS WITH REFERENCE TO SELECTED PROBLEMS OF RELIGION IN PUBLIC EDUCATION

(L. C. Card No. Mic 59-2390)

J. Leonard Azneer, Ph.D.
University of Pittsburgh, 1959

The purpose of the study was to determine whether the pronouncements adopted of the national Jewish community relations, congregational, educational, and rabbinic bodies dealing with the problem of church-state relationships as it relates to the public school are necessarily indicative of the attitude of the American Jewish community. The thesis sought to ascertain whether there might be a significant minority of Jewish leaders who did not agree with the national agencies on the question of religion in our public schools.

The study undertook to investigate the attitudes of Jewish leaders toward selected problems of religion in the public school. It attempted to describe and analyze the attitudes of these leaders to the questions:

1. Should public school properties, organization, machinery, etc., be used for religious observances or worship during school hours?
2. Should the public school engage or cooperate in programs designed specifically to introduce religion into the school curriculum?
3. a. Should church or synagogue buildings be used for public school classrooms in communities lacking adequate classroom facilities or during periods of emergency or disaster?
b. Should public school buildings be used by religious institutions for education or worship when school is not in session or during periods of emergency or disaster?
4. Should government aid be given to schools under the supervision or control of any religious denomination or sects?

A total of 300 opinionnaires were initially sent to a group of Jewish leaders. The group was composed of 75 social workers, 75 educators, 75 rabbis, and 75 lay leaders in the area of Jewish Education.

An analysis of the responses to the opinionnaire indicates that there is no single attitude that may be represented as the view universally agreed upon by Jewish leaders to either the general question of religion in public education or to selected problems of religion in public education. While there appeared to emerge a general endorsement of the principle of the separation of Church and State by the Jewish community leaders surveyed, it was also noted that many of them are often ready to compromise this issue because its implementation might strain

relations between the Jewish or nonJewish community or because of economic considerations.

It is suggested that an investigation be initiated into a selected number of situations where there has been a readiness to compromise the principle of the separation of Church and State by Jewish lay leaders to determine whether and how the attitudes of the Jewish professionals have been affected by the apparent readiness of the lay leaders, who engage their services, to compromise this important principle.

It is further suggested that additional study be undertaken to explore whether Jewish leaders functioning on the local community level are satisfied that the national agencies are speaking what the majority of them believe. If it should emerge that the local leaders believe that the national agencies are not the truly representative voices of the Jewish community, such a study might seek to determine how the local leaders would recommend that this situation be rectified so that the national pronouncements should more accurately reflect what the totality of Jewish leadership feels about these issues.

Microfilm \$2.75; Xerox \$9.60. 212 pages.

THE ORGANIZING PRINCIPLE IN THE CURRICULUM OF CHRISTIAN EDUCATION: PROTESTANT TRENDS

(L. C. Card No. Mic 59-1840)

Irene Smith Caldwell, Ph.D.
University of Southern California, 1959

Chairman: Professor Paul B. Irwin

The current emphasis in Protestant religious education on the theological and distinctively doctrinal aspects of the religious body appears to require a theologically oriented philosophy of religious education. In the development of such a philosophy, it becomes necessary to have an organizing principle whereby theological content, on the one hand, and methodology, on the other, are integrated in curriculum building. The problem of this study was to determine trends which seem to be emerging in regard to the nature of the organizing principle in Protestant religious education. Since the organizing principle has its foundations in both theological assumptions and learning theory, a treatment of these two areas became an essential part of the study.

An analysis of historical documents and of the proposals of early theorists revealed two conflicting and antithetical philosophies as to the nature of the organizing principle. The one represented the traditional approach and centered on how the message of the Church could be presented most effectively. The Bible and church creeds were the organizing center. The other developed an

educational viewpoint based on philosophical and scientific thinking. This experience-centered approach sought to direct and enrich the learner's response to his environment.

In the analysis of the efforts of early and contemporary theorists to resolve this conflict and to find a sound theory of curriculum, seven rather distinct organizing principles emerged: (1) the experience-centered theory, (2) the theological content-centered theory, (3) the parallel principle, (4) the functional theory, (5) the character traits theory, (6) the great themes theory, and (7) the relationship theory. For the purpose of comparison an identification was made of the organizing principles of the curriculum contained in recently approved statements of educational philosophy by four denominational bodies. In general, the emphases found in the theorists are clearly reflected in the denominational documents.

The most pronounced development is the present effort to incorporate into educational theory current Biblical and theological thought and corresponding insights of dynamic psychology. It is within this context of the new theological-psychological rapprochement that the organizing trends become apparent. These are as follows: (1) a recognition of man's existential anxiety and sense of predicament, (2) the requirement of deep changes within the self whereby the learner may increasingly realize the potential self, (3) the centrality of interpersonal relationships—the covenant-community in which God is redemptively at work—in effecting changes in the self, (4) the educational use of Biblical themes relevant to the self's predicament and need of change, and (5) the concept of Divine confrontation in and through the developmental processes and decision-demanding life situations corresponding to the Biblical themes.

Contemporary Protestant educational theory is clearly based upon a philosophy of encounter whereby deep changes are brought about by confrontation and decision within the context of the Christianity community. It retains the early emphasis upon experience, but experience grounded in a more realistic concept of man and a recognition of the Divine initiative. Education retains its social orientation but it is a social process in which the self is re-created or restored to wholeness. It is through the learner's participation in the fellowship of the Church "redemptively alive" that method and the truth contained in content find their integrating center. It may be concluded that the Church is the organizing principle of the curriculum in Protestant Christian education.

Microfilm \$3.20; Xerox \$11.00. 247 pages.

**A HISTORY OF LUTHERANISM IN THE
ANDHRA DESA (THE TELUGU TERRITORY
OF INDIA) 1842-1920**

(L. C. Card No. Mic 59-1944)

Martin Luther Dolbeer, Jr., Th.D.

The Hartford Seminary Foundation, 1957

Please see page 278 for abstract.

Microfilm \$6.15; Xerox \$21.40. 481 pages.

**HISTORY OF THE CHRISTIAN DAY SCHOOLS
AFFILIATED WITH THE NATIONAL
UNION OF CHRISTIAN SCHOOLS**

(L. C. Card No. Mic 59-2398)

Milford Franklin Henkel II, Ph.D.
University of Pittsburgh, 1959

This is an investigation of the background, underlying causes, development, organization, and philosophy of the Christian day schools affiliated with the National Union of Christian Schools.

The method was historical, and included studies of the records and publications of individual schools, the National Union of Christian Schools, the National Association of Christian Schools, the Christian Reformed Church, the Reformed Church of America, and the True Reformed Protestant Dutch Church. A questionnaire was sent to each of the schools to gather historical data and to compare the philosophical responses of the administrators of the Christian schools with the Christian school teachers. Twenty representative philosophical statements were selected and the teachers and principals were asked to indicate their reactions to the statements. The statements were then ranked according to the degree of acceptance or rejection, both on a weighted scale and on a percentage basis.

The Christian schools of the National Union had their theological beginnings in the Synod of Dort and other Reformed Confessions. Albertus C. Van Raalte, and other leaders of the immigrants, favored the Christian schools and this was one of their reasons for coming to America. However, the common people, because of poverty and indifference, were not greatly concerned about the Christian schools.

Immigrants started some Christian schools, but in many areas these were supplanted by public schools. A renewed doctrinal emphasis along with the establishing of the Christian Reformed Church gave impetus to the Christian school movement. Dutch was the common language, although English was also taught in many of the Christian schools. The teaching of Dutch had a religious significance, and even the earliest schools were decidedly Christian. Their theological base prevented them from becoming merely nationality schools. Had they been, they probably would have died out with the establishing of public schools and the Americanization of the group.

The Christian schools have tended toward segregation and isolation. The National Union of Christian Schools has for many years also promoted Christian schools among nonReformed evangelicals. The Union was influential in the establishing of the National Association of Christian Schools, which now also reaches nonReformed people. Fear of doctrinal impurity limits cooperation between the Reformed and nonReformed Christian schools.

The Christian schools are costly and the Reformed churches help to bear the burden of the schools. The salaries of the Christian school teachers are below the salaries of the public school teachers. Findings indicate that there will probably continue to be a shortage of Christian school teachers as long as the schools continue to expand. The economic situation of the teachers will continue to improve, and teachers will likely be granted tenure.

The Christian schools are established upon two basic

philosophical concepts: the implications of covenant theology, and parental control of the school society. There is a high degree of consistency in the philosophical concepts of the teachers and administrators. However, the Christian schools need to develop a more definite philosophical and psychological system.

The National Union of Christian Schools is now on a sound financial basis. Their "Educational Foundation" makes possible the development of distinctive Christian textbooks and other aids to the Christian school movement. Based upon history it may be predicted that the Christian school movement will probably continue to grow.

Microfilm \$10.25; Xerox \$36.80. 818 pages.

**THE THEORY OF SERMON ILLUSTRATION
AS REVEALED IN TEXT BOOKS AND
OTHER PERTINENT WRITINGS ON
PREACHING, 1880-1955**

(L. C. Card No. Mic 59-2401)

John Paul Lambertson, Ph.D.
University of Pittsburgh, 1959

This dissertation is an endeavor to discover what authors of textbooks and other writers on preaching have said about the theory of sermon illustration during a 75-year period, 1880-1955. It is an attempt to show what emphases have prevailed, what agreements or disagreements have been registered, and what trends are discernible. It is an effort to show what similarities exist between viewpoints expressed by writers on preaching and opinions advanced by contemporary writers in the related fields of speech and psychology.

It seemed clear that any attempt to show agreements and disagreements, emphases, trends or observations from related fields could best be done in relation to the following broad topics which were discussed by most of the writers: the nature and kinds of sermon illustration, the importance of illustration and its relation to the sermon, the purposes of sermon illustration, the sources of sermon illustration, and rules for employment of illustration. These topics, in relation to the questions for which answers are sought, constitute the elements of the problem.

The method of research involved the searching of libraries to discover primary sources and secondary materials. In each case the section of the library devoted to preaching was explored. By examining indexes and scanning chapter and section headings it was possible to determine whether a book or article contained any information pertaining to sermon illustration. The following libraries were searched: the central Carnegie Library of Pittsburgh; the Library of Pittsburgh-Xenia Theological Seminary; the Library of Western Theological Seminary, Pittsburgh; the Library of Union Theological Seminary, New York City; and the Library of Congress. Approximately 200 books, magazine articles, and theses yielded useful information. Once the data and materials were in hand, they were organized under topics and subtopics; then they were examined and analyzed.

The following are among the principal findings and conclusions:

In the light of long-prevailing agreement that an illustration must throw light upon the subject, excessively long or numerous illustrations which obscure the truth should be avoided. The truth is primary; illustration is secondary.

Writers on preaching agreed throughout on the value of illustration in arousing and sustaining interest. Modern speech text authors stress the importance of interest factors in speeches. Though a few writers on preaching have explored the nature of interest, the subject warrants more study and treatment by authors of textbooks on preaching.

In consideration of the sustained emphasis on the value of the familiar in attention and in learning, an emphasis supported by present-day writers in related fields, it follows that illustrations should come from areas of life familiar to the hearer.

In an effort to reach the whole person, a recent trend in illustration calls for an enlarged use of narrative and dramatic techniques. A few writers have noted the non-logical sources of most personal action. These findings should be included in more of the systematic texts on preaching.

The sharp and continuing division of opinion concerning the advisability of employing personal experiences in the pulpit leads to the conclusion that this source of illustration should be used very sparingly.

Preachers have been encouraged throughout the period studied to employ many sources of illustration. It is assumed that the modern preacher should add to experience, invention, and observation an acquaintance with many areas of reading and especially with the Bible, biography, and modern history.

Observance of the following rules of illustration was insistently and repeatedly encouraged: accuracy, brevity, economy, familiarity, relevancy, suitability, variety, and vitality.

Microfilm \$2.10; Xerox \$7.40. 158 pages.

**CRITICAL REQUIREMENTS FOR DIRECTORS
AND MINISTERS OF CHRISTIAN EDUCATION
IN THE PRESBYTERIAN CHURCH IN THE U.S.A.**

(L. C. Card No. Mic 58-2037)

William George Rusch, Ph.D.
University of Pittsburgh, 1958

This investigation used the critical incident technique to compile a list of critical requirements for Directors and Ministers of Christian Education in the Presbyterian Church in the U.S.A. Field Directors of Christian Education provided a list of churches used as the sample. One hundred seventeen churches located in 31 states and the District of Columbia provided 301 questionnaire booklets containing 1,072 usable incidents from which 1,532 behaviors were abstracted.

The list of critical requirements was derived inductively from the reported behaviors. Eight major areas of activity were identified:

- I. Developing an effective educational staff and program for achieving the aims of Christian education in the local church.

- II. Teaching, guiding, and assisting those who are taught and led in the Christian education program.
- III. Providing and promoting the Presbyterian program, The Faith and Life Curriculum, and supplementary materials which agree with Presbyterian belief and reflect sound educational theory and practice.
- IV. Informing parents and enlisting their support and cooperation in the Christian education program.
- V. Maintaining an effective relationship with the Christian Education Council, the official boards, the pastor, the church staff, and special commissions.
- VI. Enlisting the support of the congregation in the Christian education task and cooperating with the church and its several organizations in fulfilling its responsibility.
- VII. Creating and cooperating in community programs and working with community leaders.
- VIII. Evidencing Christian personality, and providing leadership; manifesting Christian conviction, witness, character, and attitude; and personal preparation by prayer and study for the role of leadership.

A number of additional variables were investigated: comparison of the reports of the laity, clergy, and educational personnel; effects of the size and type of community and the size of the church of the respondent; effect of the age and sex of the respondent; comparison of quite recent behaviors with those occurring within the past year; comparison of laity reports concerning

directors of Christian education with those concerning ministers of Christian education; comparison of the effective and ineffective behaviors of the directors and ministers of Christian education reported by the laity, taking them first together and then individually; a comparison of reports of laity who are members of Christian Education Councils with laity who are not. The method of chi square was used in determining the significance of differences.

Significant differences which could not be attributed to chance sampling fluctuations were reported in the following: more clergy reports in Areas V and VI; more suburban community reports in Area I; more female laity reports in Area VIII; more reports from laity under age 50 in Area I, more reports from laity over age 50 in Area V; more effective reports concerning directors of Christian education in Area II; more ineffective reports in Area V; more ineffective reports concerning ministers of Christian education in Area VIII.

The list of critical requirements derived from the reported behaviors, apart from its value as a tentative definition of the responsibilities of directors and ministers of Christian education in the Presbyterian Church in the U.S.A., could probably be adapted to the following practical uses: in the formulation of a job analysis booklet, containing the 309 statements of critical requirements, which might provide the basis for an employment contract between a local church and its educational personnel; as a check list for evaluating the work being done by educational personnel in local churches; as a guide in designing a curriculum for the preparation of educational personnel; as an aid in enlistment of those desiring to prepare for educational leadership in the churches; and as a guide in directing in-service training programs.

Microfilm \$4.95; Xerox \$16.60. 386 pages.

SOCIAL PSYCHOLOGY

SOCIAL CONFORMITY AND AUTHORITARIANISM IN THE MARINE CORPS

(L. C. Card No. Mic 59-2442)

Richard William Firestone, Ph.D.
New York University, 1959

Adviser: Dr. Isidor Chein

The purpose of this study was to explore some hypotheses suggested by recent theory as important variables underlying the phenomenon of social conformity. The investigation focussed on changes in the authoritarian attitudes of Marine Corps recruits during the basic training period. Recruits were seen as attempting to gain entry into the group (Marine Corps) during "boot camp." In order to do this, it was assumed that they would have to conform to values communicated to them by their NCOs and Officers.

A 30-item F-scale was administered, before and after training, to 500 Marine recruits in 10 platoons, with DIs in charge of each platoon. The DIs then rated the 10 "best" and 10 "worst" Marines in each platoon. The F-scale was then administered to the DIs and 44 additional NCOs, and to 28 Officers.

Through profile analysis, an evaluation was made of the similarity between the various F-scale profiles of individual recruits and a mean NCO profile, a mean Officer profile, and the individual F-scale profiles of their respective senior DIs. In order to evaluate changes in agreement on the separate F-scale items by the recruits as a whole, Average Deviations were computed for each item, before and after training, using data of the general group described below.

Three experimental groups of recruits were assembled; a general group (N = 75) to represent the overall sample, a group of "best" (N = 30) and a group of "worst" (N = 30) Marines.

The hypotheses under investigation were:

- I. Amount of social conformity is a function of the amount of communication.
- II. Conformity is a function of the importance of the issues being presented.

III. Preferred individuals will be more conforming than non-preferred individuals.

Hypothesis IA tested the prediction that NCOs, because of greater proximity, would exert more influence over changes in recruit attitude patterns than would Officers. Although this hypothesis was confirmed at better than the 5% level, and there was evidence of attitude change, there was no indication of the anticipated attitude conformity by recruits. Hypotheses IB and IC, predicting the greater influence which individual DIs rather than the overall NCO group might exert over changes in recruit attitude patterns, were not confirmed.

Hypothesis II, suggesting that recruit agreement would converge more on F-scale items which were more consistently and intensively reacted to by the NCO group, was not confirmed.

Hypothesis III, also not confirmed, predicted that the "best" recruits would conform more to the influence of NCOs than of Officers, while the "worst" would be essentially unresponsive to any influence. After combining these two groups to increase the N, hypothesis IA was "cross-validated," with the results tending to confirm earlier findings.

It was speculated that this pattern of results may have reflected the effect of social influence if not of social conformity. Because of this lack of evidence for social conformity and certain other tentative findings, it was also suggested that behind the mask of behavioral conformity exhibited by Marine recruits after "boot camp" lay a groundswell of rebellion which could only be covertly expressed. And finally, a logical alternative to the above speculations was conceded to the effect that the change in attitude patterns of the recruits may have been essentially a function of their having just completed a difficult training experience, rather than being related to the social influence factors herein studied.

Microfilm \$2.00; Xerox \$4.60. 86 pages.

THE RELATIONSHIP BETWEEN INSECURITY, SELF-ACCEPTANCE, OTHER-DIRECTION AND CONFORMITY UNDER CONDITIONS OF DIFFERENTIAL SOCIAL PRESSURE

(L. C. Card No. Mic 59-1981)

Herbert William Gross, Ph.D.
The University of Buffalo, 1959

The purpose of this study was to determine the relationship between conformity and the personality variables of insecurity, self-acceptance, and other-direction under conditions of strong and weak social pressure.

Riesman has developed the thesis that the dominant mode of insuring conformity in our present day American society is other-direction, i.e., relying on "cues" from peers as a basis for an individual's judgments. On the basis of Riesman's theory and Fromm's consideration of conforming individuals as being insecure and having low self-acceptance, it was hypothesized that insecurity and self-acceptance would be related to conformity in the weak

pressure condition and that other-direction would be related to conformity in all conditions.

Previous studies have indicated that pressure toward conformity is related to public as opposed to private expression of responses by subjects in a group setting and to the presence or absence of the influencing group. Using these variables, three situations of varying degrees of social pressure were devised. One was a strong pressure condition in which subjects made judgments publicly while in the presence of their influencing peers. The intermediate condition was one in which the subjects were in the presence of the influencing group but did not make their judgments public. In the weak pressure condition the subjects made their judgments privately and were not face-to-face with the influencing group. The subjects were 271 high school seniors and their task was to judge the number of paper airplanes on each of two cards briefly exposed to them. Social pressure was manipulated by giving the subjects spurious information regarding group averages.

Three weeks after the conformity data were collected, three personality scales were administered in a systematically varied order to the subjects by one of the high school guidance staff. Insecurity was measured by the Maslow S-I Inventory, self-acceptance by the Berger S-A Scale and other-direction by an Other-direction-Inner-direction Scale devised by the present writer.

Reliability for the conformity measure was determined by correlating the subjects' conformity behavior for both cards. The measure proved to be sufficiently reliable for research purposes. A comparison of the three social pressure conditions indicated that social pressure resulted in more conformity than occurred without social pressure. Strong social pressure tended to result in more conformity than weak social pressure but the results were not definitive.

An examination of the correlations between the conformity scores and the personality scales revealed that there is no relationship between conformity and insecurity, nor is there a significant relationship between self-acceptance and conformity. Conformity is related to other-direction in both the weak and strong conditions. Those subjects who conformed in both the strong and weak conditions did not differ on the personality variables from those who did not conform in both conditions. The correlations between conformity and other-direction for those subjects, however, were significant.

The lack of relationship between conformity and insecurity may be due to the tendency of some insecure individuals to relate poorly to groups. The same phenomenon may account for the lack of relationship between self-acceptance and conformity. In addition, self-acceptance appears to be related to acceptance of others, which might facilitate yielding to group pressure among people high on the self-acceptance variable. Other-direction is related to conformity, giving support to Riesman's conception of that social character type. There is a tendency for the relationship to be greater for females than males, which may be due to differences in the cultural sex roles. This suggests a need for future research on possible sex differences in the manifestation of other-direction.

Microfilm \$2.00; Xerox \$5.00. 97 pages.

PRETEST-TREATMENT INTERACTION EFFECTS IN ATTITUDINAL STUDIES

(L. C. Card No. Mic 59-1916)

Robert Edward Lana, Ph.D.
University of Maryland, 1958

Supervisor: Associate Professor Elliott McGinnies

This study was designed to investigate the interaction effect of a pretest consisting of a questionnaire, and a treatment consisting of a persuasive communication, in an attitude change experiment. An examination of the effect of administering the posttest some time after the application of the treatment was also made. A third purpose was to examine the effect of the administration of a pretest on the posttest variance. A four-minute taped pro-vivisection talk was utilized as the treatment. The dependent variable was attitude toward vivisection, measured by a ten item Likert-type questionnaire.

Five experimental groups were formed from five sections of the Introductory Psychology class at the University of Maryland. One group was pretested with the vivisection questionnaire, listened to the tape twelve days later and was posttested with the same questionnaire immediately afterwards. Twelve days after the posttest was administered the first time the questionnaire was again presented. A second group heard the tape and was posttested immediately without having been pretested. Group III filled out the questionnaire once. The fourth group was pretested and then posttested twelve days later without having listened to the tape. The fifth group, which was not a part of the principle design, was pretested, listened to the tape twelve days later, and then was posttested twelve days after treatment.

The vivisection talk was effective in changing attitudes toward vivisection, but there was no evidence of an interaction effect of pretest and treatment. The variability of the posttest scores was not significantly affected by the administration of a pretest. It was demonstrated, in addition, that the posttest results were not affected by varying the time interval between treatment and posttest from zero to twelve days.

It is concluded that the administration of a pretest in the "pretest-treatment-posttest" design in attitudinal studies does not necessarily sensitize an individual so that his reaction to a persuasive communication is differentially affected. Also, the administration of a pretest does not necessarily affect posttest variability, nor does the immediate use of the posttest affect the amount of attitude change. Microfilm \$2.00; Xerox \$3.00. 44 pages.

AN INVESTIGATION OF THE CONCEPTS OF THE SELF, MATE, PARENTS, AND IDEAL IN RELATION TO DEGREE OF MARITAL SATISFACTION

(L. C. Card No. Mic 59-2361)

Eleanor Braun Luckey, Ph.D.
University of Minnesota, 1959

This research was designed for the purpose of testing some hypotheses suggested by and common to the three major orientations which have dealt specifically with marriage counseling: the psychoanalytic, the socio-psychiatric, and the role and self theory.

From the areas of overlap and general consensus of the three orientations, five hypotheses relative to marital satisfaction were formulated and tested separately according to sex. It was held that there is no difference in population means between two groups defined as satisfactorily and less satisfactorily married in regard to: (I) the degree of congruence between the concept each spouse holds of himself and the concept of him held by his marital partner; (II) the degree of congruence between one's self concept and the concept of his ideal; (III) the degree of congruence between the subject's self-concept and his concept of the parent of the same sex; (IV) the degree of congruence of the concepts the subject holds of his spouse and of his parent of the opposite sex; (V) the degree of congruence of the concept the subject holds of his ideal self and the concept he holds of his spouse.

The two samples investigated were designated as "satisfactorily" and "less satisfactorily" married on the basis of high and low couple scores on 23 items of the Locke (Predicting Adjustment in Marriage, 1951) and Terman (Psychological Factors in Marital Happiness, 1947) marital scales. From 454 respondents (University of Minnesota students, 1948-50) 40 "S" couples and 41 "U" couples were selected. The two samples were found homogeneous in regard to 26 items of descriptive personal information.

The Leary Interpersonal Check List (Multilevel Measurement of Interpersonal Behavior, 1956) was used to measure concepts of self, spouse, mother, father, and ideal self. Discrepancy scores were computed and transformed to meet the assumptions of normality. The significance of differences were tested by means of the t-test.

Statistical analysis of the data revealed that: (I) Satisfaction in marriage was related significantly to the congruency of the husband's self concept and that held of him by his wife; but was found unrelated to the agreement of the concepts the wife holds of herself and that which her husband holds of her. (II) Marital satisfaction was significantly associated with congruence of the husband's concepts of self and ideal self, but the results were not clear when congruence of wife's self and ideal self were tested (2 out of 4 tests indicated significance). (III) Husbands in satisfactory marriages identified themselves with their fathers to a significantly greater degree than did the less satisfied. This was not true of wives identifying with their mothers. (IV) Associated positively with marital satisfaction was congruence of wives' concepts of their husbands and fathers; the relationship of the congruence of wives' and mothers' images as held by husbands was unclear. (V) Both husbands and wives in the S group saw their spouse as being like their own

self ideals to a significantly greater degree than did those in the U group.

When the data were subjected to a less precise method of scoring and analyzing and no sex division was made, all null hypotheses except the second were rejected.

The findings of this study are construed in general as supporting the theory that the interpersonal relationship which exists in marriage is influenced by each individual's perception of self and significant others, and that in specified instances the degree of congruence of concepts is positively related to satisfaction in marriage. Sex differences were evidenced in four out of five hypotheses and congruence of concepts held by the husband was more often associated with satisfaction. Further research is suggested to verify and clarify these findings.

Microfilm \$3.65; Xerox \$12.40. 284 pages.

EFFECT OF PRIOR GROUP MEMBERSHIP ON CONFORMITY

(L. C. Card No. Mic 59-2259)

Dorothy Murgatroyd, Ph.D.
University of Pennsylvania, 1959

Supervisor: James C. Diggory

The present project was an attempt to study the influence of the individual's participation in one group upon his conformity to the contradictory consensus of another group. It was hypothesized that the individual who had experienced agreement with his own opinion in a group consensus composed of individuals he perceived as having high ability would show greater deviation from group norms in a group with contradictory norms in regard to the same matter than an individual who had experienced the same kind of agreement in a group composed of individuals he perceived as having average ability. It was also hypothesized that the individual who had experienced agreement with his own opinion in a group consensus would show greater deviation from group norms in a group with contradictory norms in regard to the same matter if he perceived the group as low in liking than an individual who perceived the group as composed of individuals who particularly liked each other. It was further predicted that the least amount of change would be shown by the individual who first participated in a high ability group and then entered a group low in liking while the most change would be shown by the individual who first participated in an average ability group and then entered a group high in liking.

Volunteer subjects were given a preliminary group session in which they made a decision in regard to the disposition of the case of a juvenile delinquent. They perceived their fellow group members as having "high ability" or "average ability" by experimental induction. All subjects experienced agreement with their judgment in the matter by both other group members. In a second group session they were told they would get along well or poorly with each other on the basis of an individual data sheet administered after the previous session. They then found the subjects in disagreement with their judgment in regard to the same case. Agreement as well as the correct decision was made necessary in order for the group to win

a prize. The scale positions on six successive check-list rating sheets were analyzed by Alexander's General Test for Trend. The following results were obtained:

1. Individuals who have experienced agreement with their own opinion in a group consensus composed of individuals they perceive as having high ability show greater deviation from group norms in a group with contradictory norms in regard to the same matter than individuals who have experienced the same kind of agreement in a group composed of individuals they perceive as having average ability.

2. Individuals who have experienced agreement with their own opinion in a group consensus do not show any greater deviation from group norms in a group with contradictory norms in regard to the same matter if they perceive the group as low in liking than individuals who perceive the group as composed of individuals who particularly like each other. However they do show different rates at which they change toward conformity.

3. The least amount of change was shown by the individuals who first participated in a high ability group and then entered a group high in liking while the most change was shown by individuals who first participated in an average ability group and then entered a group low in liking. In between these were the "high ability-low liking" treatment and the "average ability-high liking" treatment groups.

The failure to confirm the hypothesis in regard to liking has been attributed to the fact that either differences in liking do not produce differences in conformity after a previous group experience in regard to the same matter or the "liking" induction in this experiment was too weak to overcome the "ability" manipulation. A further test of this is suggested using sociometrically evaluated friendship groups instead of the present induction.

Microfilm \$2.00; Xerox \$3.00. 47 pages.

CRIMINAL SELF CONCEPTIONS IN THE PENAL COMMUNITY: AN EMPIRICAL STUDY

(L. C. Card No. Mic 59-1688)

William Nardini, Ph.D.
State University of Iowa, 1959

Chairman: Professor Robert G. Caldwell

The major problem and concern of this research was to determine why first-time offenders in a penal institution come to think of themselves as criminals. In determining why individuals come to think of themselves as criminals, the relationship between criminal self conception and certain other crucial variables were established. These other crucial variables included the offender's reference groups, reference categories, the kind of criminal act committed, and the offender's length of sentence, feelings of guilt and length of stay in prison.

The theoretical frame of reference for this study was Sutherland's differential association theory reformulated in terms of self-reference-group theory. Glaser was the originator of this reformulated theory.

The relationship between criminal self conception and the above related variables was scientifically tested by

means of an intensive study of first-time offenders in the Iowa State Penitentiary. The sample was a non-random one because of the limited number of first-time offenders at that institution. The sample consisted of one hundred and twenty-eight first-time offenders who had been in prison for varying lengths of time.

The above variables were measured through the use of a closed-end questionnaire which was developed on the basis of two pre-tests given prior to the study. In the statistical analysis of this data use was made of Chi Square.

The findings of this study indicate quite clearly that those inmates who have a criminal self conception tend to have negative reference groups, longer sentences, have committed the more serious crimes and are more likely to feel that they are guilty of the crime for which they were convicted.

Microfilm \$2.00; Xerox \$7.00. 147 pages.

SOCIAL INFLUENCE ON PERCEPTUAL JUDGMENTS OF CHRONIC SCHIZOPHRENICS

(L. C. Card No. Mic 59-2454)

Carmi Schooler, Ph.D.
New York University, 1959

Adviser: Dr. Murray Horwitz

This study was designed to measure the effects of various factors possibly affecting the schizophrenics' readiness to be influenced socially. The basic technique used was the Asch situation. In this procedure an individual judges which of three comparison lines is the same length as a standard line after a group of the experimenter's confederates have given a wrong answer. As a result, the subject finds himself in a situation in which his judgments are challenged by those around him and in which the response he gives is a function of his readiness to be influenced by others.

The hypotheses tested were based on the general theory that the schizophrenic process involves a progressive deterioration of responsiveness to the social environment. Thus it was predicted that the amount of conformity shown would be inversely related to the degree of the subjects' illness.

Two other variables were also investigated. It was hypothesized that schizophrenic subjects to whom the confederates are introduced as normals would conform more than those to whom the confederates are introduced as mentally ill peers. This hypothesis was introduced to study the possible effects on the hospitalized schizophrenic of the lack of contact with normals which characterizes his usual hospital environment. Secondly, it was predicted that the amount of conformity exhibited would be increased by the presence of conditions directed at increasing the amount of normative and informative pressure. This hypothesis was included as a means of investigating the effectiveness of possible sources of motivation which might serve to induce the schizophrenic to emerge from his social withdrawal. In terms of interaction effects it was predicted that healthier subjects would be more responsive to differences in the nature of the social pressure and the apparent mental health status of the confederates.

Forty-eight regressed subjects, forty-eight partially remitted subjects and twenty-four normal controls were tested. The major hypotheses were not supported by the experimental data. The variables under consideration only effect the amount of conformity shown in terms of a triple interaction which indicated that for the regressed subjects the informative condition was more effective when presented by normal than by peer confederates. In addition, the regressed subjects, although able to respond correctly on a pre-test, produced a number of responses which conformed to neither the group's choice nor the correct answer. Furthermore, the number of these responses was increased significantly under the normative and informative conditions, indicating that these regressed subjects are in fact responsive to the immediate social environment.

In addition, an interview was administered to examine the subjective correlates of the subjects' experimental performance. Analyses of the interview data showed that the regressed subjects reported themselves as being less highly motivated, less aware of the relevant discriminanda and less self-confident than the others.

No significant differences were found between the experimental performances of the partially remitted and normal subjects. The interview responses of these two groups were also generally similar.

The results of this study were seen as contradicting the basic hypothesis that the schizophrenic process involves a progressive deterioration of responsiveness to the social environment. Instead of being less responsive than others to the immediate social environment, the regressed subjects were more responsive. In the Asch situation, however, this increased responsiveness takes the form of producing responses which conform to neither physical or social reality. Microfilm \$2.35; Xerox \$8.20. 180 pages.

A STUDY OF THE ADJUSTMENT OF PERSONS OVER SIXTY-FIVE YEARS OF AGE IN THE FIVE BOROUGHES OF THE CITY OF NEW YORK BY SMALL SAMPLING TECHNIQUE

(L. C. Card No. Mic 59-1051)

Stanley S. Willing, Ed.D.
New York University, 1958

Chairman: Professor Roland H. Spaulding

The sample group in this study was chosen by use of the small sample technique and the County Tracts of the Bureau of the Census. The group was composed of 1018 persons in 724 households in the five boroughs of the City of New York.

The method for collecting data was a combination of the mailed questionnaire and a personal interview checkup. The questionnaire utilized was the Your Activities and Attitude Schedule developed by the Committee on Human Development of the University of Chicago.

A series of mailings was used by the researcher to check the status of the subjects before mailing the actual questionnaire. Results of this showed 158 had moved, leaving no forwarding address. Forty-nine were deceased and eleven reported as senile by relatives.

The total number of questionnaires mailed was eight

hundred. Completed questionnaires were received from four hundred and sixteen. Nothing was heard from two hundred and sixty-four; the balance of 120 were returned incomplete. Ninety-five personal interviews were completed.

There are two major scores on the Your Activities and Attitudes Schedule, one for each part. There are also fourteen sub-tests, seven in each section. On the Activities Section the men showing good adjustment outnumbered the women eight to one. Sixty-six and six tenths per cent of the group had good or average adjustment. On the Attitudes Section seventy-five and six-tenths per cent of the group had good or average adjustment.

The highest correlations between total adjustment and individual sub-tests were found to be Leisure and Recreation, Intimate Contacts and Security. This was in the major Activities Section. In the Attitudes Section the highest correlations were in Health, Life Attitude and Friendship.

Individuals in the study group who were still working showed the best adjustment. Almost fifty per cent of the men were found to be still employed, either part or full time. The responding women stated that thirty-eight per cent of those who had been in the labor market were still in it.

The respondents' stated desires or felt needs by frequency of answer were as follows: good or better health (336); better housing (178); to be useful (153); more money or security (147); to be loved or wanted (124); desire for health of loved ones (59); return to old country (57); longevity (31); return of youth (18); happy or painless death (17); return to life of loved ones (9).

The researcher came to these conclusions.

The entire area of compulsory retirement should be reexamined with a view to creating a more flexible attitude

towards those who wish to continue in employment. Employment means more than just money to many - it is status, belonging, the feeling of being useful and alive. It is the vehicle by which one may hold up his head in a job-centered society.

The social and religious workers of the country should study the implication of almost one-third of the respondents stating they wished they were wanted and/or loved. The feelings of rejection pervaded the answers of a great many of the older persons in this study. They must be made an integral part of community life.

Concern with health was another weak spot brought forth in this study. Health plans for the elderly are skimpy or non-existent. The voluntary health programs do not recognize the disabling illnesses of old age. The older person, in the vast majority of cases, does not have the wherewithal of financing his own rehabilitation or health program. Some joint effort by the private, governmental, and insurance agencies is of paramount importance shortly.

A broad view housing program is called for on the basis of the respondents' answers. Over forty-three per cent stated they needed better housing. Almost of equal importance is the type of housing. Special facilities are required for the safety and mental health of the elderly. These should not be in segregated projects as the older people wish to be in a natural setting with persons of all ages.

The religious leaders appear to have failed in their contacts with this older group. Few of the respondents attend church regularly. They do not feel a strong affiliation with any denomination. With the onset of large groups living longer the churches have much ground to make up.

The problem of adjustment of the older person is a multi-disciplinary one and cannot be solved unless the various groups serving the elderly cooperate. All must work together so that the new longer life will be a worthwhile life. Microfilm \$2.85; Xerox \$9.80. 220 pages.

SOCIOLOGY

SOCIOLOGY, GENERAL

NATIONAL IMAGES OF BUSINESS AND POLITICAL ELITES IN TWO BORDER CITIES

(L. C. Card No. Mic 58-5307)

William Vincent D'Antonio, Ph.D.
Michigan State University, 1958

The present study grew out of a general concern with factors which might affect technological interchange in a cross-cultural situation. Since national political boundaries offer citizens of different nations opportunity for daily interaction, the United States-Mexico border area was selected as the site for research into this problem. It was assumed that the national images which these citizens had of each other might be influential in the change process. It was further assumed that individuals occupying important positions in the political and business systems of their communities would be influential change agents.

The top elites of these two systems for the twin cities of El Paso and Cd. Juarez were chosen for a study which related variables of contact, occupation and nationality to the images which they held of themselves and each other. To achieve this it was necessary to have:

- 1 - a description and analysis of the business and political elite systems of the two cities;
- 2 - a description and analysis of cross-cultural contacts, including an estimate of differential amounts of contact among the four elite groups;
- 3 - data on the substantive images which the four elite groups had of themselves and each other.

It was found that the business elite systems of the two cities were similar in general nature, although the El Paso businesses were significantly larger in size. In the political systems the judiciary seemed to be more important in the United States and the executive more important in

Mexico. The business and political elites of El Paso formed a well integrated unit with business apparently dominating. In Cd. Juarez there was a cleavage between the two groups with both struggling for power.

It was found that the Cd. Juarez business elites had significantly more cross-cultural contact than any of the other groups; yet their images didn't differ significantly from the political elites of Cd. Juarez. Moreover, there were no significant differences in images based on amount of contact by nationality. It was further found that nationality was a primary variable in accounting for imagery when the four groups were compared with each other in different ways. Occupation was not significantly related to imagery on the basis of the data of this study. Finally, it was found that the four elite groups tended to have highly favorable images of American businessmen and government officials and their respective practices. The images of the corresponding Mexican groups was much less favorable, with the two American groups having generally negative images while the Mexicans tended to see these practices as about the same in both countries. The Cd. Juarez businessmen were the most self-critical of the four groups tested.

The findings suggest that interaction can take place even when images are not congruent or favorable, if the situation is highly structured so that role behavior is predicated upon the status-equality of the particular actors in the situation.

Microfilm \$3.45; Xerox \$11.80. 267 pages.

THE STRUCTURE OF AUTHORITY IN REGIONAL PLANNING: A STUDY IN THE SOCIOLOGY OF LEGITIMATION

(L. C. Card No. Mic 59-2482)

Idris William Evans, Ph.D.
The University of Texas, 1959

Supervisor: Walter Firey

The present study is an investigation of the Tennessee Valley Authority as a formally organized, federal, regional social planning agency situated in a democracy. The study analyzes threats to the survival of the planning social system which arise externally to the system itself and which thus become important in the assessment of the rationality of organizational action. Attention is focused on such problems because of their traditional neglect by regional sociology, the sociology of social planning, and the sociology of formal organization.

As a central hypothesis it is proposed that "the rational regional orientation of legitimation and strategy is a necessary and sufficient condition for the survival of the regional planning agency in a society committed to responsible government as a prominent value." The "Dixon-Yates" power proposal is presented as an example of a threat to a system (the TVA) originating externally to the system. It is argued that the TVA survival of this potential threat was in large measure contingent upon the support of the TVA in the committees of the Congress. For this finding to be consequential for the basic hypothesis,

however, it is necessary to relate the variable of Congressional support to the property of legitimacy.

Legitimacy is defined as a quality ascribed by a plurality of actors to a normative order which they perceive to be expressive of values possessing positive axiological significance. Validity is defined as the extent to which an actor believes an order is legitimate for others. The rational actor seeks outwardly to maximize the order to which he ascribes validity (whether it is legitimate for him or not). Thus, the survival of the politician depends upon his maximization of symbols the popular legitimacy of which is given periodic expression at the polls. The political agent's behavior may be taken as an indirect expression of the popular legitimacy ascribed to an order by his constituency. Since the survival of the TVA was contingent in part on the support of Congressmen from regions outside the Tennessee Valley, it is concluded that extra-regional legitimacy was in this case a condition of survival. Because it was created in accordance with specified procedure, the TVA as the creature of a rational-legal order enjoys automatic legality, but its legitimacy remains problematical, contingent upon the success with which it identifies itself with popular values. Its survival, then, was contingent in part upon its extra-regional legitimacy, which in turn was contingent upon extra-regional legitimation. On this basis, the negative hypothesis is rejected: The regional orientation of legitimation was not a sufficient condition for survival in the present instance.

A secondary hypothesis is that "a necessary condition for the survival of a regional planning agency is the rational pursuit of rational-legal, traditional, and charismatic legitimacy outside the boundaries of its regional incidence." Weber's concepts of charismatic and traditional legitimacy are redefined, rational-legal status is rejected as a basis for claiming legitimacy, and the category of secular legitimacy is introduced as a third basis for claiming legitimacy. An extensive analysis of the literature of the TVA demonstrates the superiority of the revised scheme for ordering the data of legitimation.

Consideration is also given to some of the unique problems of legitimation inherent in the federal-regional authority structure, two of which are particularly striking. One is the problem of extra-regional secular legitimacy, the establishment of which is impeded by the poor quality of the economic measurements presently available. The other is the resistance of vested interests and traditional values to the innovation of supra-state planning structures; this, too, undermines the legitimacy of the TVA, for the establishment of other such regional agencies would progressively negate the charge of regional favoritism.

Both major hypotheses are rejected on the strength of the present findings, but in both cases the way is pointed toward constructive reformulations. The tentative conclusion may be stated as follows: a necessary condition for the survival of the regional planning agency in a democratic society is the pursuit of creative, conservative, and secular legitimacy outside the boundaries of the planning region.

Microfilm \$4.00; Xerox \$13.40. 310 pages.

**ADJUSTMENT OF LARGE
DOWNTOWN AND BOULEVARD CHURCHES
IN LOS ANGELES TO SOCIO-CULTURAL
FACTORS IN THE COMMUNITY**

(L. C. Card No. Mic 59-1843)

Merle Edison Fish, Jr., Ph.D.

University of Southern California, 1959

Chairman: Professor Neumeyer

The problem was to study some of the adjustments which large downtown and boulevard churches in Los Angeles have made to the sociocultural factors in the community life. It was hypothesized that churches which adapt their programs and services to the age groups and the interests of their membership and to the changing sociocultural factors in the community or area from which they draw their constituencies are more likely to succeed.

Data were gathered by means of a questionnaire sent to every twentieth member of the four churches studied, and an interview with each minister. A 61 per cent return was received from 422 persons sent the questionnaire.

Findings. (1) the roles of the minister have become that of preacher and administrator to the virtual exclusion of the role of pastor. (2) The major social characteristics of the members of the churches studied are: (a) The age ranges at the extreme ends of the population pyramid show marked differences with that of the city population range. There are twice as many people in the age bracket 60-and-over and half as many in the age bracket 10-and-under, as in the general population of the city. (b) The income of the members is relatively low; 57 per cent indicated incomes below \$5,000 per year, and only 10 per cent reported themselves in the \$10,000-and-over income bracket. (c) The members are highly educated, 25 per cent having completed college, and an additional 21 per cent indicated some college training. (d) These churches tend to be one-class churches with 80 per cent indicating white-collar classifications of work.

(3) The participation of the church member in the activities of the church varied directly with the distance of his residence from the church, and the pulling power of the churches in recruiting new members rarely exceeded 10 miles. (4) Religion tends to become more subjective and personal rather than social in its expression. (5) Members of the churches are aware of the changing complexity of the neighborhoods in which their churches are located and want the church to adapt its program to meet these conditions. Two of the churches tested are making adjustments both to the community and to their own membership, and all four of the churches are making some adjustments to the changing sociocultural factors of the community. These adjustments make for greater success in terms of membership and financial support. Variety in the program to meet the varying needs of people of a multiplicity of backgrounds is the chief problem of adjustment. (6) Thirty-seven per cent of the respondents indicated some racial exclusiveness; however, each church had a few members of the nonwhite races. It is assumed that with the degree of prejudice registered, integration of others than Caucasians would affect the church membership adversely.

Conclusions. (1) A church of less than 2,000 members of the downtown or boulevard type in Los Angeles cannot do effective enough work to continue to maintain its

membership. (2) Secularization of the church creates a tendency to make the minister into the "general manager" of the church. (3) Racial prejudice is not an acute problem, but it is a nominal one in the churches studied. (4) The large growth for these churches is over. They will not be able to remain static without loss of membership. But regardless of what they do there will be little chance of growth. (5) The age factor appears to be the most important influence on success. More middle-aged people are needed to balance the large number of the elderly and the lack of children and to provide leadership.

Microfilm \$2.00; Xerox \$6.80. 145 pages.

**AN ANALYSIS OF THE SENTENCING
PRACTICES OF CRIMINAL COURT
JUDGES IN PHILADELPHIA**

(L. C. Card No. Mic 59-2234)

Edward Green, Ph.D.

University of Pennsylvania, 1959

Supervisor: Thorsten Sellin

Previous studies of the sentences received by convicted offenders conclude that there is a lack of well defined criteria for sentencing, that judges project their prejudices into the sentences they impose, or that there are undue disparities in the sentences of different judges for crimes of similar gravity. A critique of these studies reveals that their conclusions proceed from questionable assumptions or inadequate methods of experimental control. This study is an investigation based upon data derived from official court and police records of the city of Philadelphia of factors which influence the sentences meted out to convicted offenders. A statistical analysis is made of the sentences in a sample of 1437 cases according to legal factors, non-legal factors, and factors in the criminal prosecution.

The legal factors consist of the gravity of the crime measured according to the statutory maximum penalty permitted by the statutes, the number of bills of indictment in the accusation, and the prior criminal record of the offender. There is a significant positive association between the variables constituting these factors and the severity of the sentences. The non-legal factors investigated are sex, age, race, and region of nativity of Negro offenders. The data show that there are differences in the types of crimes committed and in the incidence of recidivism between the categories of these classifications. The control of legal factors in making the comparisons results in the rejection of the hypothesis that differences in bio-social traits affect the severity of sentences.

The factors in the criminal prosecution according to which the sentences are analyzed are differences in the judges hearing the cases, differences in the district attorneys prosecuting the cases, and differences in the pleas of the offenders. The investigation of the degree of consistency in sentencing among the judges is preceded by the construction of an index with which to measure the gravity of the cases. The variables utilized are the legal criteria of sentencing--the type of crime committed, the number of bills of indictment in the charge, and the number

of convictions of felony in the prior criminal record. The sentences of the judges are compared within three categories of cases which are differentiated according to whether the index scores are low, intermediate, or high. The degree of consistency among the judges is observed to vary according to the degree to which the cases move from intermediate gravity toward the poles of seriousness or mildness. There is the least disparity in the most serious and the least serious cases; the greatest inconsistency occurs in cases of an intermediate grade of seriousness. There are no significant differences in the sentences of cases prosecuted by different district attorneys with the judge held constant. There are no significant differences according to type of plea. The one exception is in cases of minor crimes against personal property for which offenders who plead guilty get milder sentences. This is hypothesized to be due to the mitigating influence of making restitution.

The major conclusions differ from those of other studies. The findings demonstrate that the legal criteria of sentencing impose marked restrictions on the judge in sentencing. There is no evidence of discrimination against minority groups in sentencing. The data suggest that disparities in sentences are caused partly by differences in legal philosophy but, even more, by difficulties in the formation of clear impressions of defendants as minor or serious offenders.

Microfilm \$2.40; Xerox \$8.40. 182 pages.

OCCUPATIONAL ASPIRATION AND SOCIAL MOBILITY OF SELECTED RURAL MINNESOTA MALE HIGH SCHOOL GRADUATES

(L. C. Card No. Mic 59-2357)

B. M. Abdul Majeed Khan, Ph.D.
University of Minnesota, 1959

The principal problem of this research is a 'dynamic assessment' of occupational choice behavior among rural and small town male high school graduates under differential impact from urbanization. In previous studies, the investigators appeared to have taken a relatively static point of view upon factors affecting the occupational aspiration process. Many of these studies appeared also to be theoretically inadequate. The present study maintains a definite theoretical frame of reference, that of the interactionists' point of view. The research is an extension of this point of view in explaining the occupational choice behavior of rural and small town youths.

Four independent variables related to primary group relations and one variable measuring some aspects of native ability of the subjects were selected. These were each tested for association with a number of dimensions of occupational aspiration behavior. Some of these dimensions were assessed through a number of perceptual variables and others through time as an intervening variable.

The sample consists of responses of male graduates of six high schools for the classes of 1948, 1950, 1952, 1954 and 1956. Four of these schools were selected from northeastern Minnesota, characterizing the State's low income farming area, and the remaining two from southwestern Minnesota, characterizing the State's one of the

most prosperous farming area. The respondents from the Southwest were taken to represent psycho-socially, a relatively homogeneous farm or rural oriented type as compared to the respondents from the Northeast.

The results of the study indicate that the occupational aspiration behavior of the young men sampled reflect probable influence of changing shared meanings and values among contemporary rural youths. The change is least evident in the more homogeneous and agriculturally prosperous Southwest area sample than in the Northeast. The rural youths of less prosperous Northeast area tend to represent a marginal group in that they are moving from a rural to urban environment. As such, they do not appear to be completely oriented toward either the rural or the urban occupational values. The social-psychological marginality of the Northeast rural youths is reflected in their (a) more negative orientation toward their family and community, (b) "unrealistic" perception of objective possibilities in attaining of vocational goals, and (c) audience-type response to mass communication.

Microfilm \$2.00; Xerox \$6.80. 141 pages.

INDUSTRIAL RELOCATION OF DISPLACED MALE FACTORY WORKERS: SOME SOCIOLOGICAL IMPLICATIONS

(L. C. Card No. Mic 58-3352)

Michael Lalli, Ph.D.
University of Pennsylvania, 1958

Supervisor: W. Rex Crawford

The primary purpose of this study was to find out whether certain social factors were associated with limiting time lost from work for 524 male factory workers who suddenly lost their jobs because of a shutdown, how they were differentially reabsorbed among the local industries, and how the old and new jobs were compared by six factors: wages; foremen, friendliness of co-workers; type of work; opportunities; and physical conditions on the job.

Questionnaire, personnel and interview data were collected. The sample consisted of 285 respondents who did not differ significantly from the non-respondents for age, ethnic group, marital status, seniority, and education. The sample was divided several ways: workers under forty and those forty year old and over; native born and foreign born; Americans, Italians and Central Europeans. The data were analyzed to answer the following questions: How much time did the men lose from work? Were age, number of relatives, number of dependents, number of friends, club membership, and ethnic background related to time lost? Who procured better or worse jobs after the shutdown? How did they find their new jobs? In what industries were the men reemployed? Did some industries show age and ethnic preferences?

Only a few empirical findings can be listed here. For the Central Europeans there was a significant association (.05) between time lost from work and the number of relatives. This was not true for the other ethnic groups, age or nativity groups. Number of dependents was significantly associated with time lost from work for the

Italians and the older men. Marital status made a difference only for the Americans. A tentative explanation of these findings was based on different generational and ethnic definitions of familial obligations.

There was a trend for those with more friends to lose less time from work, and having no friends was more of a handicap for the older men. Club membership was not a significant association; those who did not belong to clubs were more successful in limiting time lost from work. Findings regarding friends and clubs were interpreted according to possible personality differences, age-dependency needs, and the functions of voluntary associations for working-men.

Comparing the old job to the new, the younger men did significantly better than the older men for five of the six factors measured. In each instance the Americans did better than either the Italians or the Central Europeans. About three-fourths of the men reported that wages were the same or better on the new job; eight out of ten found their new co-workers just as friendly or friendlier; and three-fourths thought their new foremen were as good or better. These factors, emphasized in sociological literature as important to the worker, appear to be commonly and easily found by the ordinary workingman.

Regarding industrial relocation of the displaced workers, the significant difference was age. Older men remained in textiles; primary metals and rubber showed a preference for younger men; synthetic fibres hired proportionately more older men; and the electrical industry showed no age preference. The relocation pattern was generally related to wage differentials. Some trends toward ethnic concentrations are noted.

General comments were made on job attachment, the meaning of unemployment to semi-skilled workers during a period of relative prosperity, and the shutdown as a weapon in management-labor conflicts.

Microfilm \$2.60; Xerox \$9.00. 197 pages.

THE IMMIGRATION ACT OF 1952; A CASE STUDY IN POLITICAL SOCIOLOGY.

(L. C. Card No. Mic 59-2052)

Richard Harrison Robbins, Ph.D.
University of Illinois, 1959

Political sociology is an interstitial discipline drawing primarily upon sociology, political science, and social psychology. It concerns the distribution of power among group interests, whether within the special realm of government or in the general social structure. Thus it includes the internal structure of a trade union as well as such familiar problems as the relation of social classes to the state or the social character of a state's bureaucracy. Its basic concepts are group, interest, and power, but they may be employed in different ways. Attitudinal-behavioral studies stress the role of the individual in participating in voting or in affiliating with political groups. Structural studies are focused on group activity as such as the basis of the political process. Evaluative studies are differently premised; they are placed in a framework of asserted ideals and moral principles. The study here presented takes mainly the structural approach. It leans

heavily on the pioneer work of Arthur F. Bentley whose *Process of Government* was first published in 1908.

Bentley argued that the political process was but one phase of the social process of group activity. And he sought to incorporate both the concepts of attitude and ideal in the group context.

One way to examine the structural approach in political sociology is to take a single legislative act, tracing its genesis from deep-lying groups in the social system to group activity within Congress itself. The Immigration and Nationality Act of 1952, the McCarran-Walter Act, is an effective case study since its subject matter is as much sociological as political. By treating this case in terms of such social factors as public opinion, regionalism, urbanism, class and ethnic divisions, and formal group interests, the group basis of the political process is affirmed more concretely. The material is based on historical analysis, literature on private organizations and legislative hearings, and selected interviews with group representatives.

The McCarran-Walter Act is viewed in terms of restrictionist groups which urge retention of the present annual immigration quota of 154,000 and retention of the national origins system, and in terms of antirestrictionist groups which advocate moderate increase in the overall quota and either reform of, or elimination of, the "discriminatory" national origins formula. At the level of public opinion consensus is still restrictionist, although it has become flexible enough in recent years to enable more active antirestrictionist groups to win acceptance by Congress of special "emergency" legislation admitting refugees and displaced persons outside of the quota restrictions.

Within these broad lines, restrictionism is centered in the South, antirestrictionism in the Northeast. The cleavage between these social-geographic group settings represents a major conclusion of this study. The South and parts of the West are more rural, more agrarian, more homogeneous with respect to religious and ethnic groups. The Northeast and certain more densely populated sectors of the Lake States are more urban, more industrial, more heterogeneous, and they contain the bulk of the ethnic and the Catholic and Jewish populations. This pattern is reproduced among the important group interests; restrictionism is mainly supported by veterans' and patriotic societies, drawn largely from the insular areas, while antirestrictionism is mainly supported by social-religious and ethnic organizations from the great metropolitan centers of the North. In turn, within the two parties and within Congress, restrictionism is concentrated among conservative southern Democrats and mid-western Republicans, antirestrictionism is concentrated among liberal and ethnic-religious Democrats, together with a small number of liberal Republicans, all mostly from the Northeast. These group coalitions, inside and outside of Congress, are likely to persist, though periodically moderate restrictionism may be tempered by "international interest" and concern for the special plight of refugees and displaced persons overseas.

Microfilm \$3.20; Xerox \$11.00. 247 pages.

"STATUS RECIPROCITY" AND ORGANIZATIONAL BEHAVIOR

(L. C. Card No. Mic 59-2306)

Ellis LaVerne Scott, Ph.D.
The Ohio State University, 1953

This dissertation presents an exploratory study of an aspect of human relations in organized groups. The study has attempted to define in operational terms an organizational phenomenon, reciprocity of status expectations, and to examine variation in reciprocity among individuals and units of organization, and to explore the relationships between reciprocity and other organizational phenomena.

The subjects of the study were the officers and men of a squadron of ten submarines in the United States Navy. Although the study's focus has been upon naval organizations, the phenomenon analyzed is not regarded as peculiar to military organizations. It appears, rather, to be a general characteristic of man hierarchically structured organizations which possess a high degree of functional specialization, and in which superior-subordinate and peer relationships are formally defined.

The basic data were derived from organization charts and charts obtained from enlisted personnel on the submarines. On these charts each man was asked to indicate his immediate organizational relationships; his immediate superior(s), peers in the same unit as himself, and his immediate subordinates. The responses indicated on these charts were quantified and categorized and made to form the basis for the analysis.

For the purposes of this analysis, a status relationship refers to the superior, peer, or subordinate positions of members relative to one another. An expectation, operationally defined, means that a respondent has named another member as a superior, peer, or subordinate. Each person named by a respondent is considered to represent a status expectation held by the respondent. His total status expectations, as here defined, consist of the total number of persons he has named on his organization chart as immediate superiors, peers, or subordinates.

Reciprocity or nonreciprocity was determined by a comparison of these charts. If Member A named Member B as a subordinate, and Member B named Member A as a superior, the status expectations of both were regarded as reciprocated. There are two ways in which a member's expectations may be unreciprocated: (1) if A names B as a subordinate, B may name A as something other than a superior (i.e., a peer or subordinate); or (2) if A names B as a subordinate, B may not name A at all. The distinction illustrated here was utilized in the analysis.

Individual and unit "scores" were tabulated on the basis of unreciprocated status expectations. Three basic categories were used for the computation of these scores. One of these categories has been referred to as status confusion. Although members may recognize some organizational relationship to one another, in that they name one another, the status relationship may be ill-defined and the expectations may not coincide. The members differ in their definitions for the relationship. Another element in status reciprocity is status recognition. Nonrecognition occurs when the expectations of one member are ignored by the persons for whom the expectations are expressed. This element indicates, for the individual, a degree of relative social isolation or acceptance. For the unit, status

recognition indicates a relative degree of status cohesion among members. A third element in status reciprocity is sociometric leadership. The sociometric leaders are those individuals for whom a great many more expectations are expressed than they express for other persons.

In this study reciprocity "scores" were computed for individuals and for units of organization. The scores on the reciprocity variables were correlated with scores on social structure, leader behavior, and operational effectiveness variables. Considerable variation in reciprocity was found for both individuals and for units or organizations. Units studied were ships, departments within ships, and divisions within departments. Some of this variation was significantly related to other individual and unit variables.

Among larger units of organization, i.e., ships, variations in degree of reciprocity tends to be distributed over a relatively narrow range, although there may be considerable variation among subunits of these organizations. The variation in subunits tends to cancel out so that for ships the range of variation is relatively less. Within most of the ships there were both high and low subunits, both departments and divisions. One ship, however, was a marked deviant in the direction of low reciprocity. This ship was ranked lowest in the squadron in efficiency and morale.

Marked deviation in reciprocity in the larger units tends to have more operational significance for the unit as a whole than does extreme deviation among smaller subunits of organization. The relationships of various types of reciprocity to one another tend to become increasingly independent in larger units. All in all, status confusion (or lack of it) appears to assume greater operational significance in the larger units. Status recognition (or lack of it) appears to assume greater operational significance in smaller units.

At the division level, if the immediate superior (a petty officer) is by-passed in the work relations of unit members and higher-level superiors, the status relationships of members tend to become fragmented. The cohesion of the unit, as reflected in the degree of status recognition among members, is diminished. It is in this situation that informal groups may be expected to be formed. It is to be expected that one such group will be oriented around the immediate superior (a petty officer) and another around the department head (an officer). If this occurs, the expectations of the petty officer are reciprocated by only a portion of those men who are formally assigned to his division. In the same fashion, the men do not express expectations for all other members of the unit. If expectations are expressed, some of them are apt to be ignored. The by-passing of the immediate superior thus tends to alter the primary-group relations in the division.

Ratings of supervisory personnel for military leadership by superiors and by subordinates appear to be related to the degree to which the immediate superior functions as an important link in the chain of command. The petty officer who is a "man in the middle" rather than a "man on the sidelines" will be ignored less frequently in the status expectations of subordinates.

If an officer who is serving as a department head is rated high in military leadership by his superiors, the petty officers in his department will tend to be high in reciprocity of their status expectations. This officer,

whose petty officers' expectations are highly reciprocated, will receive relatively few leadership nominations from enlisted men. At first glance, it appears that an officer who is rated high by his superiors is rated low by enlisted personnel. If it is considered, however, that there are strong intermediate superiors (the petty officers) between this officer and most of the enlisted men in his unit it can be seen that this officer receives relatively fewer leadership nominations for the reason that relatively more of them are given to the strong intermediate superiors. If the petty officers are not strong links in the chain of command, the officer receives relatively more leadership nominations from the men. He is, however, rated lower by superiors.

The expectations of the by-passed petty officers are reciprocated by only a portion of their subordinates. They also receive only a portion of the leadership nominations of these men and the functional chain of command deviates from the formal pattern.

Unit morale for ship and departments appears to be related to reciprocity in some degree. This is particularly so for those aspects of morale which are defined in terms of officer-enlisted men relations and communications within the organization. The data suggest that efficient communications and high reciprocity are significantly related. Morale, as inferred from relative optimism-pessimism in estimates of group opinion, tends to be negatively correlated with reciprocity. The high reciprocity units tend to be more pessimistic than do the low reciprocity units.

Status clarity (lack of status confusion), as an element of reciprocity, appears to assume most functional significance in those units of organization in which secondary-type social relationships are most characteristic (e.g., ships). Members of more primary-type units (e.g., divisions) appear to be able to operate effectively even though status relationships among members are somewhat confused.

Another factor associated with status clarity is that of disparity of level and rank among members, particularly at the petty officer level. Petty officers who are division heads on the same organizational level may vary considerably in military rank. Just as some petty officers with relatively high supervisory responsibilities may have relatively low rank, some petty officers of relatively high rank may have disproportionately little responsibility. A person's military rank is frequently determined by factors other than his supervisory level, just as persons may be assigned to supervisory positions on the basis of considerations other than their military rank. This disparity, however, tends to result in considerable confusion in status relationships. This fact may have considerable administrative significance. If the formal system is to function as it is supposed to function, it would appear that supervisors should be given a rank commensurate with their level in the organization. At the same time members should have a position on a level commensurate with their rank if the formal system is to function effectively. Disparity between level and rank tends to reduce the significance of rank as a status symbol.

Dispersion of work relations over several echelons of command also tends to increase status confusion among members. If these work relationships extend beyond immediate superiors and immediate subordinates, the

status distinctions at this level of organization become increasingly obscured.

Some of the contradictions and discrepancies between behavior and behavior expectations which are commonly attributed to role conflict may, in fact, reflect status confusion among the members of an organization. Failure of behavior to conform to expectations cannot necessarily be interpreted as indicating role conflict, as technically defined, among members. It is possible that members' role definitions may correspond, but that their definitions of status relationships do not.

Status recognition, a major element in reciprocity, is of greater operational significance, the data suggest, in the more primary-type units (e.g., divisions). Generally speaking, nonrecognition is more common than status confusion in the organizations studied.

Another organizational factor which appears to be related to both status clarity and status recognition among members is the degree to which statuses within organizations are functionally differentiated. Some specialties may increase the status visibility of members because of distinctions based on differences in skills. Differences in prestige among occupations may also be associated with these functional differentiations. A "radar operator," for example, may have more "status visibility" than a deck hand. To the degree that members of a department tend to be differentiated in this manner, greater status clarity and recognition seems to result. The implications of differences in occupational prestige among positions within organizations have not been fully explored. Studies of this type, utilizing variations of the North-Hatt scale or other techniques, may contribute a great deal to the understanding of the complexities of social relations in these organizations. The prestige system becomes of particular analytical importance if it deviates sharply from the formal status system.

Among units at the division level, status recognition appears to assume more operational significance than does status confusion, particularly in the larger divisions. If work relations of division members are dispersed along the horizontal axis of organization beyond the immediate unit, the status cohesion of the unit tends to be reduced.

Sociometric leaders tend to receive nominations despite confusion or nonrecognition of their own expectations. These individuals also tend to receive many nominations as persons of influence in the organization. These sociometric leaders tend to be persons with extensive work relations.

The study has attempted to explore some of the relationships between reciprocity of status expectations among members and other organizational variables. As an exploratory study, an attempt was made to formulate hypotheses which may be useful in subsequent research. Some of the administrative implications of these findings have been suggested.

Microfilm \$2.00; Xerox \$6.60. 139 pages.

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ANALYSIS OF INTERACTION PROCESS
AND SOCIOMETRIC RELATIONS
DEVELOPED DURING GROUP THERAPY
WITH OFFENDERS ON PROBATION

(L. C. Card No. Mic 59-2456)

Alexander B. Smith, Ph. D.
New York University, 1959

Adviser: Dr. Henry J. Meyer, Jr.

Problem: The purpose of this study was to analyze the interaction process and the sociometric relationships in a client-centered therapy group of male offenders on probation. The following problems were investigated: (1) Does this type of therapy group follow the control-oriented phase sequence characteristic of a problem solving group? (2) Is equilibrium established in successive cycles as in a problem solving group? (3) What is the degree of participation in the group interaction for each subject and his sociometric relationships toward other members of the group at different stages during treatment? (4) What is the attitude toward authority figures and social conformity of each subject before and after treatment? (5) What are the relationships among the sociometric ratings, degree of participation, and attitude toward authority figures and social conformity? (6) What are the attitudes toward the group therapist and observer-recorder?

Population: The subjects were fifteen male adult probationers of Kings County Court, Brooklyn, New York, with an age range of 16 through 32, I.Q. range of 80 to 125, and education level of fifth to twelfth grade.

Procedure: Fifteen consecutive probation placements were divided into two groups: eight whites and seven Negroes. Each group met for 90 minutes weekly, for fifteen sessions at a non-court clinic for client-centered group therapy. The sessions were tape recorded, and in addition, an observer-recorder made Bales records of the interaction process, administered sociometric problems following the third, ninth and fourteenth sessions, and wrote up each session. During these fifteen weeks, the subjects also reported to their probation officers.

The following tests were administered before and after treatment: (1) a modified TAT consisting of ten pictures designed to elicit responses toward various authority figures; and, (2) the Bernberg "Human Relations Inventory" questionnaire, a projective test of social conformity.

Using Bales' system, the length of individual verbalizations, the number of verbal acts, and the category of each of these acts were recorded. Following the third, ninth and fourteenth sessions, the subjects completed four problems dealing with the group relations.

Findings: (1) The phase sequence of the probation therapy group showed only a slight tendency toward patterning.

(2) The profile of categories of the probation therapy group was compared with Talland's therapy group and Bales' problem solving model. In both therapy groups there was a preponderance of orientation: 55.8% for the probation group and 59.2% for Talland's group, compared with only 15.3% in Bales' model. In the Bales group, the reactive elements comprised about 50% of the total acts,

while in the probation group and Talland's group, the reactive elements were 37.3% and 25.6% respectively.

(3) The effect of the presence of the observer-recorder was studied. It was found that only one subject said he was "bothered" by the observer-recorder's presence.

(4) The subjects' attitude toward the therapist and the observer-recorder were compared. It was found that the attitudes were favorable toward both, but significantly more favorable toward the therapist.

(5) The subjects were ranked according to degree of verbal participation, and according to number of "most-least-liked" choices. The rank difference correlation coefficients following the third, ninth and fourteenth sessions were .49, .47 and .40 respectively.

(6) The subjects were ranked according to their degree of verbal participation and changes in TAT and HRI scores. The rank difference correlation coefficients were .07 and .01 respectively.

Conclusions: (1) The phase sequence of the experimental probation therapy group did not follow the phase sequence pattern of Bales' laboratory problem solving model.

(2) The absence in a probation group of a tendency to establish equilibrium is an indication that we were dealing with a group that is more nearly a therapy group than a problem solving group.

(3) The presence of the observer-recorder had little or no effect on the group members.

(4) The subjects developed stronger relationships with the therapist than with the observer-recorder.

(5) The obtained correlation between verbal participation and sociometric choice is not statistically significant.

(6) The relationship between verbal participation and changes in attitude toward authority and social conformity could not be established.

Microfilm \$3.90; Xerox \$13.20. 303 pages.

EXPLORATIONS IN COMMUNITY:
THE SOCIOLOGY OF
AMERICAN COMMUNITY DEVELOPMENT

(L. C. Card No. Mic 59-1503)

Maurice R. Stein, Ph.D.
Columbia University, 1959

One of the most important body of empirical materials available to sociologists is the large group of studies of American communities completed during the past three decades. Since these studies were largely undertaken quite independently of each other at points widely separated in time and space by investigators with differing research skills, interests and facilities, the task of ordering them in some common framework has yet to be completed. This dissertation uses these studies as the basis for analyzing the main social forces affecting American community life and aims at the establishment of a generalized theoretical framework.

Part I opens with a critical examination of the most satisfactory previous effort at developing such a theory of

community development - Robert Park's interpretation of urbanization based on the studies conducted under his direction in Chicago. Then the Middletown volumes by Helen and Robert Lynd are used for analyzing the effects of industrialization on community life. Finally, Lloyd Warner's Yankee City series provides case material on the effects of bureaucratization. These three social processes are assumed to be the main forces creating disorganization and calling forth new patterns of reorganization in American communities. The findings of the three sets of studies are woven together in the form of a middle range theory.

Part II applies this theory to several other studies to show how urbanization, industrialization and bureaucratization affect the social structure of an urban slum, a bohemia, two Southern towns, military communities during World War II and three contemporary suburbs. In each instance, the distinctive institutional system of the community is presented and the disorganizing-reorganizing consequences of the above processes traced. The chapter on suburbs brings the analysis up to the present and it is assumed that the structures and problems of this sub-community have special importance for understanding American community life in the fifties.

Part III is devoted to deepening the interpretation of modern community life. The social psychiatric consequences of suburban social systems are examined in considerable detail. A recent study of a rural village serves to show that small towns are as vulnerable to the processes described earlier as their urban counterparts. The final chapter shows how contemporary urbanization, industrialization and bureaucratization create novel forms of community disorganization, as well as patterns of reorganization.

This dissertation draws together the scattered studies of American communities and sub-communities within a single theoretical framework. In doing so, it aims at illuminating patterns of development in the past and stimulating research on present developments.

Microfilm \$3.10; Xerox \$10.60. 240 pages.

THE ORGANIZATION OF PRODUCTION IN NONINDUSTRIAL CULTURE

(L. C. Card No. Mic 59-1556)

Stanley Hart Udy, Jr., Ph.D.
Princeton University, 1958

This dissertation is a comparative analysis of 321 nonindustrial production organizations in 123 different societies of culture areas, using data collected from the Human Relations Area Files, supplemented by additional ethnographic materials.¹ Our aim, essentially, is to study certain interrelationships between four major variables: technological process, organizational structure, reward system, and institutional setting. The analysis proceeds from three working hypotheses. The first two deal with the determinants of organizational structure; the third is concerned with determinants of the reward system:

1. The structure of any production organization is partly determined by the characteristics of the technological process which it is carrying out; such determination

may be direct or it may occur via certain institutional implications of the work itself.

2. The structure of any production organization is partly determined by the nature of its institutional setting.

3. The structure of any reward system is determined by both the characteristics of organizational structure as well as by direct institutional factors, within limits set by features of the technological process.

Our object is not to test the validity of these hypotheses as such; in the form stated, they are common property. Rather, we are concerned with discovering the specific ways in which, and specific conditions under which, one alternative possibility holds true as opposed to another. For example, the fact that production organization structure depends both on technology and institutional setting is well known. Which specific aspect or organizational structure depends on technology, which depends on institutional setting, and what specific features of technology and institutional setting are involved, however, is not obvious. It is to this sort of problem that we address ourselves.

Our findings are summarized in 61 general propositions, all of which, essentially, are lower order statements of observed statistical covariation of substructures of our four major variables, organized in terms of our three working hypotheses. Thus, 14 propositions state specific relationships found between technological process and organizational structure, irrespective of institutional setting; 20 state culturally variable relationships between institutional setting and organizational structures; and 27 deal with reward systems in terms of specific forms and conditions of the alternatives alleged in hypothesis 3.

Specific conclusions are embodied in our 61 propositions. The forms of authority and solidarity exhibited by production organizations are for the most part predictable from technology independently of institutional setting. Proprietorship and recruitment patterns are, on the other hand, largely institutionally determined. Relationships between solidarity and recruitment indicate that certain technologically determined organizational characteristics, however, can be institutionalized in only a limited number of ways; four major organizational types can be discerned on this basis. Reward systems are largely institutionally determined, although technology limits the range of available possibilities. Type of reward system, however, is found to be highly associated with major organizational type, owing to the operation of parallel institutional influence.

More general conclusions include descriptions of typical organizational forms likely to be indigenous to non-industrial areas, and theories of change of such forms with reference to problems of industrialization and economic development. We find that production organizations in "tribal" societies are likely to be closer in form to industrial firms than are production organizations in "peasant" societies, owing to the possible institutional effects of organized agriculture and centralized government, in the latter. In addition, our study suggests certain observations on the concept of "cultural relativism" and the methodology of comparative social analysis.

Microfilm \$4.00; Xerox \$13.60. 311 pages.

1. See G. P. Murdock, C. S. Ford, et al., Outline of Cultural Materials, New Haven, Human Relations Area Files, 1950.

SOCIOLOGY, FAMILY

DETERRENTS TO THE ADOPTION OF
CHILDREN IN FOSTER CARE: A COMPARISON
BETWEEN A GROUP OF CHILDREN WHO HAVE
BEEN PLACED IN ADOPTION AND A GROUP
OF CHILDREN LACKING PERMANENT FAMILY
TIES, WHO ARE BEING CARED FOR BY SOCIAL
AGENCIES IN FOSTER HOMES OR INSTITUTIONS

(L. C. Card No. Mic 59-2349)

Bernice Boehm, Ph.D.
University of Minnesota, 1959

This study seeks answers to the following questions which have been of concern to social work and the general public: Are there children now receiving care in foster homes and institutions who should be considered for adoptive placement? If so, what are the factors which prevent these children from going into adoption? The study is based upon the assumption that the most adequate substitute that can be provided for a child without family ties is permanent placement with adoptive parents. The research was carried out in the child welfare agencies of New Haven, Connecticut.

Data were drawn from a detailed study of two groups of children: 1) children currently in foster care, and 2) children who had been placed in adoption within the year preceding the date of study. A random sample of children in foster care under 14 years of age indicated that approximately one-third of these children were without family ties, i.e. there had been no contact with either parent for more than one year. Comparisons were then made between this group and a group of children placed in adoption, in order to determine whether there were significant differences between them which might throw light upon the difference in their placement status.

Three major areas were considered in the study of each child, since these were the forces most likely to affect possibilities for adoption: first, the personal characteristics of the child; second, the characteristics of the child's own family; and third, the services and placement experiences provided by the foster care agency. When personal characteristics of the children in the two groups were compared, significant differences were revealed for the following attributes: current age, age at the time of initial placement, race, intelligence, physical health, symptomatic behavior problems, and conflict over parental relationships. There were no significant differences, however, with respect to sex, religion, or physical handicaps.

Significant differences were found between the families of the two groups of children with respect to marital status of the parents, presence of siblings, and the incidence of psycho-social disorders. Most of the children in the foster care group had been placed through court action because of parental neglect, whereas the parents of the adopted children had planfully requested adoptive placement.

Comparison of agency services revealed significant differences with respect to length of time under agency care, continuity of relationship with case workers, adequacy of casework with children and parents, and size of case load. The importance of agency factors was further shown when weighted scores were developed to measure current adoptability of individual children retained in foster care. This index showed that although approximately

one-third of the children in foster care should be given consideration for adoption because of a lack of parental ties, there were very few children in foster care who could be considered adoptable under present circumstances. However, the same use of weighted scores showed that two to three times as many children might have been adoptable if adoption had been planned within the first year of the child's placement in foster care.

Study findings indicate the need for improved foster care services, with particular emphasis upon more adequate case work, and special recruitment of adoptive homes for older children and children of minority groups. The major implications are those for preventive services with particularly the clarification of family diagnosis, more planful agency activity towards reunification of the family, and for legal termination of family ties if reunification is not indicated, in order that the child may secure substitute family ties through adoption at an early age.

Microfilm \$2.55; Xerox \$9.00. 196 pages.

AN ANALYSIS OF SELECTED ISSUES
IN FAMILY LIFE EDUCATION, 1958

(L. C. Card No. Mic 59-1323)

Glen A. Christensen, Ed.D.
Michigan State University, 1958

Supervisor: Buford Steffere

The literature in the newly developing field of family life education reveals a confused and uncertain condition in relation to such crucial issues as the goals and objectives of family educators, what they should be trying to accomplish, and how they should go about accomplishing it, in short, their *raison de etre*. The present study was an attempt to collect and process data that would help in clarifying these issues.

The data of the study were collected through the use of a structured questionnaire, which was sent to 855 members of the National Council on Family Relations. The total number and percentage of returns were 686 and 80.2 per cent, respectively.

The results of the study tend to confirm the confusion that is depicted in the literature. This situation is clearly reflected in such findings as those relating to the heterogeneous objectives of family educators, to the differential emphases on subject-matter, to the fact that the respondents tend to feel more closely identified with the professional organization of their own parent disciplines than they do with the National Council on Family Relations, and to the fact that they tend to favor their own background and training when responding to the various items composing the questionnaire, including especially those relating to the academic areas that offer the best basic preparation for future family educators, and to the most logical department for the teaching of marriage and family life classes. Thus, while it is clear that the family life movement has begun to assume some of the characteristics usually associated with an established discipline, it is equally clear that the field is as yet more divided than it is unified, that the loyalties of the family educators themselves are expressed more strongly in the direction of their own parent

disciplines than they are in the direction of the new and developing field of family life education.

A finding that is related to and illuminates the one just discussed is that family educators whose degrees are in home economics and family life tend to be more democratic and functional than do educators whose degrees are in sociology. Thus, the latter tend (1) to hold to objectives that are specific and academic in nature, (2) to make the greatest use of the lecture method of teaching, (3) to decide course content on the basis of a syllabus or the outline of a textbook, (4) to favor the content approach to teaching, and (5) to select the more theoretically oriented tasks, whereas the former tend (1) to hold to objectives that are general and functional in nature, (2) to make less use of the lecture method of teaching and more use of other methods, (3) to decide course content on the basis of joint instructor-class member decisions, (4) to favor a combination of the functional and content approaches to teaching, and (5) to select the less theoretically oriented tasks.

Still another related finding is that educators on the high school level tend to be more democratic and functional than do educators on the college level. Also, although this is somewhat less clear-cut, female educators tend to be more democratic and functional than do male educators.

The results of the study further indicate that the field of family life education seems to be moving in the direction of a counseling orientation. This movement is reflected not only in the large number of respondents who are doing personal counseling, but also in the fact that the majority of them feel that training in counseling should be included in the academic preparation of future family educators, and in the fact that counseling is considered to be one of the five academic areas offering the best basic preparation for persons interested in becoming family educators.

Microfilm \$4.10; Xerox \$13.80. 317 pages.

MARRIAGE AMONG HIGH SCHOOL GIRLS IN IOWA

(L. C. Card No. Mic 59-2415)

Orlando James Goering, Ph.D.
Iowa State College, 1959

Supervisor: Ray E. Wakeley

The objective of this investigation was to discover whether certain selected personality characteristics, parent-child relationships and dating experiences are associated with marriage among high school girls.

The general hypothesis tested was that role change varies with role deprivation. Role change was defined as a shift from one culturally defined pattern of behavior to another. Role deprivation was defined as the degree to which reward expectations of a given role exceed the net rewards actually available. High school marriage was regarded as a measure of role change. Three groups of measures were used to operationalize role deprivation: personality needs, parent-child relationship and dating experiences.

To test this theoretical formulation a modified ex post facto design was employed. Data were gathered from sixty matched pairs of married girls and their single controls

from schools in nine Iowa communities. Matching was done on the following characteristics: sex, age, grade, community, school, father's education and occupation, religion and family structure.

The Edwards Personality Preference Schedule was used to measure personality needs. The married group had significantly higher scores on *n* Order and *n* Endurance and significantly lower scores on *n* Heterosexuality. The non-pregnant subgroup of married girls scored significantly lower on *n* Autonomy. None of the hypothesized differences in personality needs was supported.

The Stone fairness in discipline scale, the Nye parental acceptance scale, the Landis-Stone parent authority scale, and a mother-daughter communications index constructed for this study were used as negative measures of role deprivation. These measures failed to discriminate between the married and single girls with one exception, married girls reported significantly greater acceptance of their parents. None of the hypothesized relationships in this area was supported.

The hypothesized relationships in the area of dating experience were generally supported. Girls who married prior to high school graduation began dating and going steady earlier, dated more frequently, had more steadies and had fallen in love with a greater number of their boy friends than did the control girls. Additional data indicated that the married girls experienced less cultural deterrents to early marriage than their controls.

The failure of hypotheses to be supported most likely could be attributed to the post factum gathering of data and inadequacy of measures employed. Implications for further research in this area were suggested.

Microfilm \$2.00; Xerox \$6.60. 139 pages.

SOCIOLOGY, PUBLIC WELFARE

A SOCIOLOGICAL ANALYSIS OF THE VALUE SYSTEM OF PRE-WAR JAPAN AS REVEALED IN THE JAPANESE GOVERNMENT ELEMENTARY SCHOOL TEXTBOOKS, 1933-1941

(L. C. Card No. Mic 59-1924)

Un Sun Song, Ph.D.
University of Maryland, 1958

Supervisor: Dr. Bruce L. Melvin

The elementary school textbooks of pre-war Japan reflect the "ideal values" which were held by the persons in power and propagated through the formal educational instrument. The *Shūshin* and *Kokugo* Textbooks of the period 1933-1941 were analyzed with a sociological frame of reference to learn these values.

Permeating every facet of social life was the belief in an otherworldly ethic which gave a divine sanction to the state's control over the society by making the Emperor a charismatic figure with certain holy and mysterious qualities. This ethic found its expression in everyday life through the shrines and shrine-worship, and through the numerous national and local festivals and holidays which were observed by the people. In history and mythology the otherworldly ethic was also strong as evidenced by the cosmogenic myths of the Japanese which fill the pages of the texts.

Relationships dealing with the political institution--the state--were governed by the two basic values of loyalty and nationalism, both of which were based upon the idea of the on (blessing) and the repayment of the on by means of loyalty to a superior who had the attribute of benevolence. Duty to the nation and Emperor was the highest expression of loyalty, and of primary importance in times of peace as well as war. This loyalty was not regarded as a passive thing, but was to be shown through one's positive actions. Nationalism, on the other hand, was evidenced by a manifest pride in the Japanese nation, and its industrial development of modern times, as well as a pride in the fact that Japan was a "land of the gods." Emphasis upon the Japanese nationalistic symbols such as the flag, sword, national anthem, holidays, and the language itself, points to a dominant concern with the idea of nationalism.

Filial piety in family relationships represented a broad value which included ancestor worship, worship of the Shinto Deities, reverence of the Emperor and service to the nation, as well as setting the parents' minds at ease. Fidelity was a second value which was encouraged in the family institution, although it dealt more specifically with the relations between husband and wife.

Group welfare in the economic practices was the value under which were subsumed the sub-values of cooperation, frugality, diligence, creativity, and independence and self-support. All of these sub-values tended to reinforce and solidify the cohesion of the group. Another group-oriented value which was dominant within the educational system was social harmony, which was directed toward the attainment of the smooth functioning of social relationships in the society and consisted of such components as manners, obligations, sincerity, honesty, and benevolence. Self-discipline finds its expression in patience and calm, body training, and orderliness. Learning was another value in the educational institution.

From a broader perspective these values indicate certain value orientations which prior to World War II seemed to characterize the society as a whole. The study of the textbooks showed that traditionalism had primacy over rationalism, particularism over universalism, vertical over horizontal emphasis in interpersonal relations, and collectivity- over self-orientation. All of these orientations are ones which would facilitate the creation of a totalitarian state for they emphasize the subordination of the individual to the power of some status, require the individual to give first consideration to the needs of the state, and militated against a change in the status quo, assuring the government that the end product of the educational system would be a subject who was obedient, willing to die for the state, respectful of authority, and not disposed to changing the system.

Microfilm \$3.85; Xerox \$13.00. 300 pages.

SOCIOLOGY, RACE QUESTION

THE PREJUDICE-INTERACTION HYPOTHESIS FROM THE POINT OF VIEW OF THE NEGRO MINORITY GROUP

(L. C. Card No. Mic 59-2068)

Ernest Works, Ph.D.
University of Illinois, 1959

Earlier empirical work has demonstrated that white people who interact with Negroes under conditions of intimacy and status equality are less likely to be prejudiced toward Negroes than white people not interacting with Negroes under these circumstances. This study was designed to study this relationship from the point of view of the Negro minority group. On the basis of earlier studies and considerations of husband-housewife role differences, the following assumptions were formulated:

1. Negro tenants in interracial housing are more likely to experience intimate and equal status contacts with whites than Negro tenants in all-Negro housing.
2. Negro housewives in interracial housing are more likely to experience intimate and equal status contacts with whites than their husbands.
3. There is no difference between segregated housewives and husbands with regard to contacts with whites.

From these and the Prejudice-Interaction Hypothesis, it was hypothesized that:

- I. Negro tenants in the interracial project will be less prejudiced toward the white tenants than Negro tenants in the all-Negro project.
- Ia. Negro housewives in the interracial project will be less prejudiced toward the white tenants than their husbands.
- Ib. There will be no difference in prejudice toward white tenants between segregated housewives and husbands.

From the theoretical conception that misinformation is instrumental in the development of inter-group prejudice, it was hypothesized that:

- II. Negro tenants in the interracial project will have more information about the white tenants than Negro tenants in the all-Negro project.
- Ila. Negro housewives in the interracial project will have more information about the white tenants than their husbands.
- Iib. There will be no difference in information about white tenants between Negro housewives and husbands in the all-Negro project.

From theorizing that favorableness of self-conception derives from the position occupied within the social system, and assuming that Negro tenants in the interracial project occupy positions which are equal to the positions

occupied by whites, while the positions of Negro tenants in the all-Negro project are inferior to the positions of whites, the following hypotheses were derived:

- III. Negro tenants in the interracial project will have more favorable self-conception than Negro tenants in the all-Negro project.
- IIIa. Negro housewives in the interracial project will have more favorable self-conceptions than their husbands.
- IIIb. There will be no difference in favorableness of self-conceptions between housewives and husbands in the all-Negro project.

Data bearing upon these hypotheses were gathered in a large low-income housing project. It was separated by a main thoroughfare, on one side of which 46.1 per cent of the units were occupied by Negroes, while on the other side 93.5 per cent were occupied by Negroes. The former

was conceived as approximating the interracial situation. The latter was conceived as approximating the all-Negro arrangement. Interviews were conducted with 77 tenants on the uniracial side and with 67 on the interracial side.

Analysis of data provided support for assumptions 1 and 2, and for Hypotheses I, Ib, II, IIb, and IIIb. Hypothesis Ia was supported on the affective component of anti-white prejudice. No difference was found on the cognitive and action components.

Results for Hypotheses IIa, III, and IIIb, while in the expected direction, failed to reach statistical significance. Analysis of scales designed to provide pre-project self-conceptions disclosed that the assumption of pre-project equality in self-conceptions, basic to Hypotheses III, IIIa, and IIIb, was contradicted. Therefore, these hypotheses were reformulated to focus upon improvement in self-conceptions rather than absolute favorableness. Analysis by this approach provided support for Hypotheses III, IIIa, and IIIb. Microfilm \$2.05; Xerox \$7.20. 155 pages.

SPEECH-THEATER

MATILDA HERON, AMERICAN ACTRESS

(L. C. Card No. Mic 59-2026)

Alberta Lewis Humble, Ph.D.
University of Illinois, 1959

This study aimed to assemble the available information about the life and career of Matilda Heron, a significant but neglected American actress, and by chronicling her career to discover what kind of an actress she was.

Miss Heron left no published material about herself and her work. Local stage histories and memoirs provided background; portraits, letters, and miscellaneous materials from theatre collections in libraries and historical societies were helpful, but not sufficiently comprehensive. Consequently, it was necessary to depend largely on newspapers and periodicals of the time. From a detailed search of these sources I was able to construct the major facts of her life and a detailed chronology of her acting career.

Matilda Heron was famous as a star of the American theatre from 1856 to 1865. During that period she was generally acknowledged to be the greatest Camille on our stage. After that, her reputation dwindled and she was soon forgotten.

The actress who had this meteoric career was born in Ireland December 1, 1830. Her family came to Philadelphia when she was twelve and there, at the Walnut Street Theatre, she made her stage debut February 17, 1851. Her first triumph was in California in 1854.

In 1855 she saw *La Dame aux Camélias* in Paris and made her own translation of the Dumas play. She began to gain fame with *Camille* in 1856 in St. Louis and New Orleans. In 1857 the impact of her *Camille* upon New York won her stardom and, ironically, marked the highest peak of her career.

Her next eight years were comparatively successful.

By the mid-sixties, however, her health was failing, marital difficulties impinged upon her work, and the brilliance of her reputation began to fade.

In her last years Miss Heron was prematurely old and impoverished. She tried to make ends meet by taking pupils, by selling her plays, and now and then, often disastrously, attempting a come-back as an actress. She died March 7, 1877.

The study of her life provides a picture of her as a person and as an actress. Her personality and temperament made her a noted performer, yet limited her success. Her impulsive, quixotic nature aided her in developing a style of acting which was new, but also led her into excesses on the stage and in her private life that contributed to her decline.

She ignored tradition and theatrical conventions to follow her own impulses. She hypnotized audiences and most critics by the intensity with which she lived her roles, and she electrified them by her outbursts of passion. She introduced interpretations of plays and characters never before seen in America.

Her acting was termed "realistic"--she remained "in character"; she spoke conversationally and ignored the audience; she included realistic details in character, costume, and setting; and she did not idealize or refine her characters.

Miss Heron's tempestuous style of acting limited her to one type of role--the "emotional"--and to one type of play--the "sensational." The public tired of both. When her magnetism failed, she had no artistic discipline to fall back on.

Perhaps because her success was so brief, Matilda Heron has largely been overlooked by historians. Nevertheless, she played a not inconsiderable part in the transition from nineteenth century traditional romantic acting to the realistic acting of the twentieth century.

Microfilm \$4.70; Xerox \$15.80. 366 pages.

THE POLICIES AND PRACTICES OF
WALLACK'S THEATRE, 1852-1888

(L. C. Card No. Mic 59-2029)

Cecil Derwent Jones, Jr., Ph.D.
University of Illinois, 1959

This dissertation analyzes the policies and practices of the theatrical organization known as Wallack's Theatre and evaluates its work and significance during the period when a member of the Wallack family was actually in control. James William Wallack and his son, Lester, sought to establish an ideal London theatre in New York. The major importance of their work is that they succeeded, in so far as was possible, in the achievement of this goal.

Organized under the stock system, the acting company was composed chiefly of English-trained actors who had established reputations before joining Wallack's. The managers employed these players to fill the traditional "lines of business," and through policies of courtesy and liberality, the services of a large number were retained for long periods. Outstanding for their individual ability and for the polished excellence of their ensemble playing were such actors as W. R. Blake, John Brougham, J. H. Stoddart, Charles Fisher, Mark Smith, John Gilbert, Charles Walcot, George Holland, Mrs. John Hoey, May Gannon, Madeline Henriques, Mrs. George Vernon, and Fanny Morant. Although the company's over-all strength declined in its later years, the work of Harry Montague, Osmond Tearle, Rose Coghlan, Ada Dyas, Mme. Ponisi, and Effie Germon still won high critical praise. The Wallacks were frequently criticized, however, for failing to develop young actors.

In its best years Wallack's was basically a house of comedy relying heavily upon the "old" English comedies. Variety was provided by the production of current English comedies and romantic melodramas. In its last decade spectacular melodramas assumed first importance in the repertory. The majority of plays performed at Wallack's, like the actors who performed them, came from London. The managers did little to encourage American playwriting.

The policies controlling the organization of the theatre, the conduct of the acting company, and the repertory were fundamentally conservative. With the exception of the abolition of benefit performances, Wallack's stood as a symbol of traditional methods. Such changes as the long run, the playing of matinees, and the single play bill were accepted with great reluctance. Policies regulating the number of rehearsals and the payment of royalties, however, were progressive.

For better than twenty-five years Wallack's was patronized by the educated and socially prominent classes of New York, and it thereby helped to make theatre fashionable. The Wallacks did all in their power to provide comfortable, attractive, and safe accommodations and courteous and efficient service to insure the continued support of these patrons.

Wallack's Theatre marked the culmination of the English domination of the American stage. It sought to revive and perpetuate the traditions of stock company organization and of English plays done by Englishmen in America. The excellence of its work gave both the best possible chance to survive, and the record of its

achievements remains as a tribute to the success which could be gained under the old methods when they were practiced by talented men of artistic taste, judgment, and refinement. Microfilm \$2.50; Xerox \$8.60. 190 pages.

SOME ASPECTS OF POLITICAL BROADCAST
POLICIES OF RADIO AND TELEVISION
STATIONS IN THE UNITED STATES

(L. C. Card No. Mic 59-2312)

Richard Merrill Mall, Ph.D.
The Ohio State University, 1952

The Federal Communications Commission contends that radio and television stations in the United States must program with the "public interest, convenience, or necessity" as primary requisites. The Commission itself has not specifically defined what "public interest" means, but in various statements and opinions, it has expressed definite judgments as to what the term includes and what it does not include.

In interpreting the "public interest" clause, the Commission has held that broadcasting must be maintained as a medium of free speech for the people as a whole. The right of the public to be informed of different opinions in matters of public controversy is the dominant consideration. Radio and television stations have a definite responsibility to provide a reasonable amount of broadcasting time for the discussion of controversial issues. The matter of political broadcasts, the licensee is a trustee entrusted with the duty of preserving radio and television as mediums of free expression and fair presentation for the general public.

Broadcasters realize the importance of this responsibility and they accept the social obligations which are a part of every station license. Unfortunately, the technical limitations of broadcasting make the total concept of "free speech" an impossibility. There is simply not enough time available for all who might desire it. It is, therefore, the individual broadcaster who is responsible for determining which issues and which speakers will be presented on his station. The broadcaster works in a context of conflicting political, economic and social forces and varying pressures from influential majority or minority groups. These factors, coupled with actions of the Communications Commission and his own personal judgments, determine the policy conditions under which his station operates.

Probably one of the values of democracy arises from the argument and debate which takes place during political campaigns. Most people feel a certain obligation to listen to political broadcasts. Perhaps the vast majority listen not so much to acquire information as to derive emotional satisfaction from having their own views expressed by men of prominence. In addition, there is a desire to hear what a man has to say for himself. The current of individual political thought is agitated by radio and television programs. This leads to a weighing of and a discussion of issues with other voters of similar opposing beliefs. Listeners to broadcast political programs think and talk about the issues and personalities brought to them over the air.

Political broadcasts contribute to the premise of democratic theory which states that when the people are fully

informed, understand the case, and know what the argument is about, they will make the right decisions or choose the right representatives to make decisions for them. The writer does not assert that the microphone and the television camera have been powerful levers in raising the level of intellectual discourse, but they have made it possible for the political speaker to reach the family group in the home where there is a chance to talk over issues in a small and familiar circle.

For more than a quarter-century the Communications Commission, the Congress, the courts, and the broadcasting industry have struggled with the complex and important problem of putting political broadcasts on the air. These years have produced a mass of legislative, regulatory, and judicial actions designed to guide or control the activities of thousands of broadcasters. The record is more intricately involved and confused for station licensees in 1952 than at any time in the past.

Despite the clouded state of affairs, the average station operator is thrust into the position of having to make decisions on parties, political speakers, their remarks, and their very manner of seeking time for broadcasts. In some cases, these decisions are covered by formal codes and declarations of principles. Much of the time, however, radio and television political broadcasting policies are conducted in an unofficial and unwritten way. Little is known concerning the role of the broadcaster himself, his political policy practices and philosophies. The reason that individual station political policy has not been extensively explored can be found in the broad scope of the broadcasting industry whose sheer size has deterred many potential research efforts.

Because political broadcasting is important and because the individual broadcaster determines which materials will be presented on his station, a research study was undertaken to provide some knowledge and understanding of local or individual radio and television station political policies.

To accomplish the purpose of the survey, the author had to secure responses from individual broadcasters throughout the United States. A questionnaire was prepared and mailed in September, 1951, to practically all AM radio stations - 2,267 of them - and to all 107 television stations. Five weeks later, a follow-up questionnaire was mailed to stations in those classes most needed to provide a reasonably good cross-section of the broadcasting industry. As a result of the two mailings, usable returns were received from 743 AM radio stations and 33 television stations. These returns, which represented a fairly accurate cross-section of AM radio stations and television stations in the United States, totaled 32.8% of all AM radio stations and 30.8% of all television stations licensed to operate in the United States.

The questionnaire itself was constructed on the premise that political broadcasting policy expressions could be obtained by examining two broad areas:

- a) The bases on which stations make time available for political broadcasts
- b) The extent and kinds of political broadcast censorship exercised by individual stations.

On the assumption that political broadcast policies might vary according to the political atmosphere, an arbitrary differentiation was established between broadcasts

made during a campaign and between campaigns. The "between campaigns" aspects of the questionnaire were ignored by a surprising number of the respondents, apparently because many stations simply do not pay much attention to political broadcasts when a campaign is not imminent or in actual progress.

On the basis of the size of the response, the kinds of individuals (usually station managers, station owners or program directors) who completed the questionnaire, and the interest shown in the results of the survey and study, the author believes that the results of the research project are a fairly reliable expression of political broadcast policies exercised by individual broadcasting stations in the United States.

Major findings of the study included the following items:

1. The majority of radio and television stations replying for the purposes of the study indicated that they sell political time during and between political campaigns. The majority refuse to give free time for political broadcasts, but this does not necessarily hold for all programs of a political flavor. Approximately two-fifths of the reporting television stations attempt to restrict the total amount of time made available for political use, while one-fifth of the radio stations actually follow this practice.

2. The majority of radio stations are not willing to cancel regularly scheduled commercial programs in favor of political materials. A commercial political program is in a better position to displace regular commercials than are sustaining political programs. New broadcasts and religious broadcasts are program types that most stations will not cancel for the presentation of political materials. Most radio stations follow a policy of selling political time at a one-time broadcast rate, allowing no discounts. Television stations are slightly more inclined to sell political time at regular rates, with standard discounts, than are radio stations. The majority of radio and television stations do not actively solicit political sales, but will accept them when offered.

3. The majority of reporting radio and television stations will sell time to actual candidates, speakers authorized to represent candidates, and to political parties themselves. Fewer stations will sell time to "probable" candidates or speakers representing potential candidates. The majority of stations indicate a willingness to sell political time to individuals or groups for the presentation of a nonpartisan point of view.

4. More than half of the reporting radio and television stations present two or more sided forum discussions on political subjects during campaigns. A sizeable number of stations, however, do not carry such forums, however, either free or charged for as regular political broadcasts. Television stations and full-time radio network affiliate stations are most inclined to present political forum discussions.

5. The majority of the reporting stations will carry "reports to the electorate" by public officials when a political campaign is not in progress, but the proportion carrying such programs decreases in marked degree when a campaign begins.

6. Few of the reporting stations indicated willingness to provide free time for types of political program materials considered of questionable desirability by networks: spot announcements of rallies, spot announcements containing arguments, dramatized political broadcasts, and political broadcasts containing impersonations, patriotic

music, parodies, or religious music. Stations preferred to sell such time or completely reject such requests. The majority of reporting stations will sell time for political spot announcements of rallies or containing arguments, while broadcasts containing impersonations or religious music find the least amount of station approval. Television stations are less liberal than radio stations in accepting these seven types of materials.

7. The majority of reporting radio and television stations restrict political expression by local news commentators or local religious speakers, but more than ten per cent of the stations will allow such news commentators or speakers on religious programs to take sides on political issues.

8. The majority of reporting radio and television stations require the submission of political scripts in advance of broadcast, with television stations and full-time network radio affiliates being most stringent in this regard. As a general rule, these advance scripts are checked by station managers, program directors, or station attorneys. Key station executives tend to give personal attention to political scripts, editing the copy to avoid the broadcast of obscene, indecent, profane, treasonable, or other undesired elements.

9. More than one-third of all radio and television stations screen political scripts to avoid the broadcast of slanderous or libelous words, a practice in clear violation of the Communications Act of 1934 at least as interpreted by the Federal Communications Commission. Many stations attempt to remove broadcasting matter considered in poor taste, bad public relations or poor broadcasting practice. In keeping with their policy of demanding advance scripts, television stations and full-time network radio affiliates are most prone to request changes in political scripts. The longer a station has been in operation, the greater the tendency to screen political scripts.

10. Most speakers accede to requests for the revision of political scripts, but a few insist on presenting the material in its original form. In this eventuality, several reporting stations indicated they exercise a policy of refusing to carry the broadcast without changes or carrying with special disclaimers. A broadcaster can protect himself from legal repercussions which might result from political broadcasts by carrying libel insurance, indemnity-waivers, or bonds on political speakers, or by using disclaimers and retractions. These devices in themselves will not prevent legal suit, but may serve to limit the extent of damages involved.

11. This report shows that network affiliated stations almost never take issue with network decisions regarding paid political broadcasts. If a political program is offered by the network as a commercial program, the majority of stations go right along with the proposition. Less than ten per cent of the network affiliates have ever refused to carry broadcasts when offered by the network as paid political fare. In the case of network sustaining political programs, the affiliates are less inclined to make station time available, but more affiliates will accept the material than will refuse it.

12. Most broadcasting stations are generally very fair in providing equality of opportunity between candidates, but one conspicuous exception occurs in the case of political broadcasts involving Communists or suspected Communists. Regardless of the fact that the law stipulates

and the Commission stipulates that candidates must be given equal opportunity, more than half of the radio and television stations reporting will not sell or give time to Communist candidates. Furthermore, they will not sell or give time to an individual suspected of being a Communist. It appears that stations which began operation after World War II are more stringent with Communists than are the older, more experienced stations.

Two findings stand forth clearly:

- a) Broadcasters lack a clear set of standards for the handling of political broadcasts
- b) Broadcasters are generally willing to carry political broadcasts, but they are concerned over the problems which surround this kind of program material.

Broadcasters seem to accept the thesis that the basis of the American system of broadcasting is not the right of the individual to be heard, but the right of the public to hear. The broadcaster accepts his position as a steward in the public interest. He accepts the problems of selection and rejection, of program balance, and of fair treatment, but he asks for consideration of all the practical aspects of maintaining station operation. He contends that his position qualifies him to understand the public interest and good programming practices. He often questions the Communications Commission's interpretations of his rights and responsibilities. This study of political broadcasting brought to light several instances in which the broadcast licensee ignored the law and the Commission to follow a course of action which he personally thought was the right one.

In conclusion, the writer offers a few principles of action to clarify the status of political broadcasting without undue disturbance for the broadcasters or the Communications Commission.

For the broadcasters, the writer makes the following suggestions.

1. In the area of political broadcasting, accept the fact of government participation and the modified interpretation of the First Amendment.
2. Whenever the industry feels that actions of the Commission exceed the boundaries of its allotted powers, offer a positive challenge in the courts and in the legislative chambers.
3. Offer volunteer cooperation, genuine cooperation, with the Commission in establishing the standards of practice for the handling of political broadcasts.

For the Communications Commission, the writer makes these suggestions.

1. In the area of political broadcasting, accept the principle that program content is important enough in the public interest to warrant positive clarifying action beyond what has previously been provided by the Commission.
2. Survey the entire area of political broadcasting, and then assemble rules and regulations to govern the presentation of political broadcasts.
3. Abandon the practice of refusing to review program content in the absence of a formal complaint and allow broadcasters to seek opinions on questionable cases before they are actually broadcast.

For the industry and the Commission, the writer makes the following suggestion.

Strive to have the provisions of the Communications Act of 1934 relating to the censorship of political broadcasts repealed as soon as possible. In a word, seek to make the broadcaster responsible for all of the political utterances made over his station's facilities, and give him full power to control the content of all material so broadcast.

None of these things would be easy to accomplish, and they would provoke a great deal of controversy, but it would be a healthy process for all parties concerned. If these actions were successfully accomplished, it would be possible for all stations to state clearly their political broadcasting policies. It is reasonable to hope that the best interests of the electorate would be served by the possession of such knowledge.

Microfilm \$4.00; Xerox \$13.40. 310 pages.

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AN EXPERIMENTAL STUDY OF RELATIONSHIPS BETWEEN SELF-CONCEPTS OF FOURTH AND EIGHTH GRADE STUTTERING AND NON-STUTTERING BOYS

(L. C. Card No. Mic 59-1858)

Gerald Walter Redwine, Ph.D.
University of Southern California, 1959

Chairman: Professor V. P. Garwood

The purpose of this study was to investigate certain relationships between the self-concepts of boys who stutter and boys who do not. The following hypotheses were tested: (1) there is no difference in the degree of favorability of the self-concepts of stuttering and nonstuttering boys; (2) there are no group self-description unique either to stuttering or to nonstuttering boys; (3) there is no difference in the degree of favorability of self-concepts of fourth and eighth grade stuttering boys.

Data were gathered from an experimenter-designed self-concept inventory, consisting of a check list of adjectives which had been selected by 90 per cent agreement of thirty professionally qualified judges. Adjectives were selected according to their favorability or unfavorability in describing personality characteristics. A pilot study was carried out using sixteen male subjects—four fourth grade stutterers, four fourth grade nonstutterers, four eighth grade stutterers, and four eighth grade nonstutterers. From the results of the pilot study the technique for the major study was devised.

A reliability study was carried out with fifty-five fourth grade boys and fifty-three eighth grade boys attending both sessions of a test-retest procedure. Reliability coefficients obtained by the use of the Pearson Product-Moment method were .66 for the fourth grade and .84 for the eighth grade. These coefficients were significant beyond the .01 level of confidence.

The major study consisted of administering the adjective check list to sixty male subjects—fifteen fourth grade

stutterers, fifteen fourth grade nonstutterers, fifteen eighth grade stutterers, and fifteen eighth grade nonstutterers. Subjects were closely matched in pairs on variables which might have influenced the measurement of something other than self-concepts as conceived in the study technique. The only difference in symptomatology was that those boys who were in the control group did not stutter, while those in the experimental group did. The .05 level of confidence was established for significance in the major study analysis.

On the basis of the findings, and considering the specific limitations of this study, the following conclusions seemed warranted.

Conclusions: (1) There is no significant difference between the self-acceptance of boys who stutter and boys who do not when compared at the same grade level measured by an experimenter-designed adjective check list. (2) There are self-descriptions significantly unique both to particular groups of boys who stutter and to particular groups of boys who do not. These self-descriptions follow: (a) fourth grade stuttering boys—"useful," "good," and "helpful"; (b) fourth grade nonstuttering boys—"kind," "good," "fair," "friendly," "thankful," and "cheerful"; (c) eighth grade stuttering boys—"happy"; (d) eighth grade nonstuttering boys—"useful," "thankful," and "alive." (3) There is only one self-attribute that is significantly different for boys who stutter and boys who do not when compared at the same grade level. This self-attribute is "just," which was chosen significantly more by fourth grade nonstutterers than by fourth grade stutterers. (4) There is no significant difference between the self-acceptance of stuttering boys of two grade levels and nonstuttering boys of the same two grade levels when measured by an experimenter-designed adjective check list. (5) There are two self-attributes which are significantly different for stuttering boys of two grade levels and nonstuttering boys of the same two grade levels. "Wonderful" was chosen significantly more for self-attribute by fourth grade stutterers than by eighth grade stutterers. "Just" was chosen significantly more for a self-attribute by eighth grade stutterers than by fourth grade stutterers.

Although this study was not designed specifically to test hypotheses relating to the influence of fathers' occupational levels upon the self-concepts of boys, additional data from tests of no hypotheses indicated that such relationships might exist.

Microfilm \$2.00; Xerox \$6.00. 125 pages.

APPLICATION OF MOWRER'S AUTISTIC THEORY TO THE SPEECH HABILITATION OF MENTALLY RETARDED PUPILS

(L. C. Card No. Mic 59-1641)

Seymour Rigrodsky, Ph.D.
Purdue University, 1959

Major Professor: M. D. Steer

This investigation was designed to evaluate the effectiveness of an experimental articulation speech therapy technique developed from Mowrer's Autistic Language Development Theory. The effectiveness of the experimental

method was compared to an application of the traditional stimulus method.

Seventy-two subjects ranging in age from 6 years to 16 years 11 months were randomly selected from the Fort Wayne State School for the mentally retarded in Indiana. The subjects were divided into two therapy groups and two control groups. One therapy group received the experimental (Mowrer) therapy and the other group received the stimulus approach. Two speech therapists administered the therapy to both groups. Of the two control groups, one received the tests administered to all subjects and the second group, under an elementary school teacher, was placed in a psychologically supportive environment. Within each of the four groups, subjects were further subdivided according to I.Q. level. In level 1, the I.Q.s ranged from 12 to 44, and in level 2, the I.Q.s ranged from 45 to 79.

Prior to and at the conclusion of the therapy program, each subject was administered a series of three speech articulation tests and a test of clarity of spontaneous speech. These results were recorded on a high fidelity tape recorder. Therapy was administered for a period of 40 days. A panel of five experienced judges listened to a random presentation of both pre-therapy and post-therapy tests, and scored them according to instructions.

An analysis of covariance was used to test for significance of observed post-therapy differences on the criterion tests. Separate analyses were made of the misarticulation of two consonant sounds (the objects of therapy) within the criterion tests. Simple and multiple correlation coefficients were employed to determine the effectiveness of certain variables in predicting post-therapy articulation scores. The variables of age, sex, reading readiness, social quotient, I.Q. family influence, etiological classification, and need for psychiatric service were considered in this analysis.

Within the limitations of the investigation the results for which statistical significance was demonstrated warrant the following conclusions:

1. Institutionalized mentally retarded subjects of the upper intelligence level achieve lower (better) adjusted mean scores than the lower level subjects as measured by the object articulation test, the medial /0/ sound and the medial /v/ sound.
2. A therapist by therapy interaction is evident in the picture articulation test, and in the medial /v/ sounds.
3. Limited to the therapy programs employed, differences in the measured articulation ability between control and therapy groups of institutionalized mentally retarded subjects are statistically non-significant. However, in comparing upper level therapy and control groups, a significant difference occurs on the initial /v/ sound favoring the therapy subjects.
4. In this experiment, no interactions of statistical significance are demonstrated for therapist by I.Q. level and therapist by therapy by I.Q. level.
5. Correlation coefficients between the post-therapy test scores and pre-therapy scores are significant at the one per cent level for the auditory stimulus test and the medial /v/ sound.
6. On the auditory stimulus test and the medial /v/

sound, post-therapy scores are significantly related to I.Q. and reading readiness scores.

7. The following regression equations obtained from the modified Wherry-Doolittle Method, help to predict post-therapy scores.

The auditory stimulus test:

$$\hat{y} = .90 \text{Pre.T.} \times \text{Pre.T.} - .73 \text{F.I.} \times \text{F.I.} + 16.10$$

The pre-therapy (Pre.T.) score in combination with the family influence score (F.I.) aid in predicting the post-therapy score for the auditory stimulus test.

B. The medial /v/:

$$\hat{y} = .498 \text{Pre.T.} \times \text{Pre.T.} + .0078 \text{Ag} \times \text{Ag} - .053 \text{R.R.} \times \text{R.R.} - 1.53.$$

The pre-therapy (Pre.T.) score in combination with age (Ag - negatively related), and reading readiness (R.R.), aid in predicting the post-therapy score for the medial /v/ sound.

8. In institutionalized mentally retarded subjects high I.Q. scores tend to be associated with high social quotient scores, high reading readiness scores, and the etiological classification labeled Familial.

The following trends although not statistically significant appear to exist in the data:

- A. Subjects in the upper experimental therapy groups achieve better articulation scores in post-therapy tests than in pre-therapy tests.
- B. Subjects in the upper stimulus therapy groups manifest inconsistent patterns between pre-therapy and post-therapy tests.
- C. Post-therapy scores tend to remain similar to pre-therapy scores for subjects in the lower I.Q. groups receiving the articulation therapy programs in this experiment.

Microfilm \$2.80; Xerox \$9.60. 214 pages.

CHARLOTTE CUSHMAN, AMERICAN ACTRESS

(L. C. Card No. Mic 59-2069)

James Willis Yeater, Ph.D.
University of Illinois, 1959

This study examines the career of Charlotte Cushman to determine the general characteristics of her acting and to reconstruct, from prompt books and contemporary accounts, the performance of her most famous roles.

It presents a scene by scene account of the stage business, blocking, interpretation and critical response to Charlotte Cushman acting in the roles she made famous.

For ten years Charlotte Cushman was a stock actress, supporting player and leading lady in various theatres in the United States. As a result of the sensational reception given her first London engagement in 1845, she became a star of the first rank, a position maintained throughout her life. She was a serious, energetic and dynamic woman and her acting reflected these traits. Her unattractive features,

lack of gracefulness and dominating self-confidence, limited the types of roles she could play. She was best in parts that permitted the expression of violent, uninhibited emotion rather than suppressed emotion.

Miss Cushman's acting was typified by great energy. Her performances usually displayed broad and strong gestures and violent movements of the whole body. This energy was manifested also in the emotional intensity of her performances, though her acting was always under control and reflected careful thought and study. Her intensity and earnestness were often so strong that they tended to obscure or distort the portrayal of softer emotions. Her acting in scenes depicting death or emotional collapse was regarded as very "realistic." Although her ability in comedy was limited, she achieved some success in a few roles. Exaggerations and mannerisms eventually caused her acting to be called "old-fashioned," but by wisely choosing her roles, she maintained her popularity.

Miss Cushman was one of the greatest Shakespearean actresses of her time. Lady Macbeth and Queen Katherine, strongly influenced by the Siddons traditions, were vivid

delineations. In these, as in other Shakespearean roles, Miss Cushman was widely praised for her ability to bring out the full beauty and rhythm of the verse without sacrificing the communication of exact meaning. As Romeo, the best known of her many "breeches" parts, she was extraordinarily popular.

Meg Merrilies, the prophetic gypsy in *Guy Mannering*, was her most famous role. There was a unique and spectacular quality about her performance that made it successful out of all proportion to the value of the play. As Mrs. Haller in *The Stranger* and Bianca in *Fazio*, Miss Cushman's genius for portraying deep emotion had the widest scope.

As a star, Charlotte Cushman acted only in parts of proven success. She inspired no imitators and established no "schools." She appeared infrequently during the last twenty-five years of her life. For these reasons she is not as well known today as Booth, Jefferson or Forrest, but in her own time she was regarded as the finest actress that America had produced.

Microfilm \$2.15; Xerox \$7.60. 163 pages.

ZOOLOGY

A COMPARISON OF LOUISIANA AND ARKANSAS POPULATIONS OF *DESMOGNATHUS FUSCUS*

(L. C. Card No. Mic 59-1081)

Allan Harold Chaney, Ph.D.
Tulane University, 1958

Chairman: Fred R. Cagle

Scope of Study: Collections of *Desmognathus fuscus* were made at six localities in Louisiana and Arkansas for purposes of presenting information about the life history of this salamander, to compare aspects of the life history of the populations, and to obtain information on the systematics of this species in these two states.

Findings and Conclusions: Statistical data has been presented on 1736 specimens and pertinent general information taken from field and laboratory observations on additional samples from the areas has been included in appropriate sections of this study.

Various measurements have been taken on salamanders from samples taken at these localities and have been plotted as ratios so that a comparison could be made to determine any significant difference among the populations. Pattern types have been established and these types have been applied to samples taken from all localities.

All of the populations studied in Louisiana were found to be similar in all aspects of the life history studied, in the measurements used as ratios, and in pattern types. However, the Arkansas populations was found to differ in the ecological habitat occupied, the time of egg deposition, the number of eggs deposited, the outward appearance and size of the larvae at hatching, the time of metamorphosis, the color pattern of both larvae and adults, growth

rate, head length/head width ratio, length of tail, time and size of attainment of sexual maturity, and maximum size attained by both males and females. In view of these differences the *Desmognathus fuscus* from Arkansas probably constitute a different subspecies from those in Louisiana. Microfilm \$2.00; Xerox \$6.60. 140 pages.

STUDIES ON LARVAL TICKS OF THE FAMILY IXODIDAE WITH SPECIAL REFERENCE TO THOSE SPECIES OCCURRING IN THE SOUTHEASTERN UNITED STATES

(L. C. Card No. Mic 59-1894)

Carleton Merritt Clifford, Jr., Ph.D.
University of Maryland, 1958

Supervisor: Dr. George Anastos

The morphology of fifty-two species of larval ticks of the family Ixodidae was studied to determine the value of certain features as taxonomic characters both at the generic and the specific level. Species of the following genera were available for study: *Ixodes* (eleven), *Rhipicephalus* (ten), *Amblyomma* (nine), *Haemaphysalis* (six), *Dermacentor* (five), *Hyalomma* (five), *Boophilus* (four), *Margaropus* (one), and *Otocentor* (one). The only major genus not represented in this study was *Aponomma* because of the unavailability of reared material. Information available in the published literature concerning certain species of larval ticks was also utilized.

Major emphasis in this study has been placed on those larval tick species which occur in the southeastern United States because of the availability of material. However,

reared material from other parts of the world was studied in order to provide a broader basis for the consideration of generic and specific characters. Both mounted and unmounted specimens were examined in most cases to insure proper interpretation of the various structures.

Chaetotaxy as well as the morphological structures previously used in larval tick systematics were investigated.

The study of chaetotaxy showed that the setae located on the body and tarsus I were of value for separating genera. Their taxonomic value was not so much in the total numbers present on any one structure, but rather in their relation to certain body landmarks. Of those located on the body proper the marginal dorsal setae were of the greatest value in separating genera. Consistent differences were noted among the genera in regard to the number of pairs of these setae located anterior to the sensilla sagittiformia. When this feature was used in conjunction with certain other morphological characters it was possible to separate the genera fairly well. The only other group of body setae that showed any value in generic separation were the marginal ventral setae. The setae on tarsus I showed some differences at the generic level that might be of value as taxonomic characters; but because of the similarity of this arrangement in several genera, it would have to be used in combination with other morphological features.

At the specific level chaetotaxy was useful primarily in separating species in the genus *Ixodes*. The following groups of body setae were of value for identifying species in this genus: the supplementary setae, the marginal dorsal setae, the central dorsal setae, the marginal ventral setae and the scutal setae. The length of the setae offered an additional means for separating species in certain instances.

The analysis of morphological structures other than setae showed certain features that were of value for the separation of genera. The structures located on the capitulum and the body were useful as taxonomic characters, whereas, those structures associated with the legs were of no value. Structures found on the capitulum and the body that were useful in separating genera were the shape of the basis capituli, the number of articles per palp, the presence or absence of eyes and the number of festoons.

At the specific level the capitular features and the structures located on the legs showed the greatest value for separating species within a particular genus. The features on the legs and capitulum that offered the most value for specific identification were exceptions to the general shape of the basis capituli, the shape of the palpi, the presence or absence of auriculae and cornua, and the dentition of the hypostome. Species in the genus *Ixodes* showed the most variation in regard to the above characters.

On the legs the number, shape and size of the coxal spurs were the only features that had any definite value. They were useful in separating the species of several genera, especially the genus *Ixodes*.

The analyses of all the above mentioned features were presented in tabular form and keys were included to demonstrate the application of these characters for the separation of genera and species.

Since the major emphasis was placed on the material from the southeastern United States, illustrations and keys (both generic and specific), as well as complete de-

scriptions, were provided for the larval ticks which occur in this area. Microfilm \$2.55; Xerox \$8.80. 193 pages.

THE EFFECT OF NUTRITION ON THE GROWTH AND SURVIVAL OF CORTISONE MAINTAINED ADRENALECTOMIZED RATS

(L. C. Card No. Mic 59-1812)

Robert Harry Davis, Ph.D.
Rutgers University, 1959

Major Professor: Dr. James H. Leathem

The level and type of whole protein fed to cortisone maintained adrenalectomized rats (Long-Evans strain) will influence growth and survival. Immature male adrenalectomized rats (60 - 65 mg.) fed a purified 20% casein diet require 0.15 mg. of cortisone acetate daily for a 20 day survival, but body weight gain was subnormal. Substitution of wheat gluten, gelatin, lactalbumin and egg albumin for casein decreased survival.

Comparison of five dietary proteins at 20% and 40% levels was made in adrenalectomized rats given 0.15 mg. cortisone acetate for 20 days. Survival was increased on 40% egg albumin or gelatin and was decreased by feeding 40% casein or wheat gluten. The high lactalbumin diet had no effect on survival. Normal body weight gain was not attained using high proteins and liver glycogen was not enhanced.

Increasing daily cortisone acetate from 0.15 to 0.3 mg. decreased survival in casein fed rats, but improved survival in rats fed the other proteins. More liver glycogen was usually obtained with the higher steroid dosage. Kidney and testis glycogen, generally, remained unchanged. However, gelatin fed adrenalectomized rats did exhibit a slight alteration in kidney glycogen. Protein and lipid composition of liver, kidney and testis were primarily influenced by diet.

Methionine addition to various diets is known to cause nitrogen retention. Methionine supplementation of wheat gluten or casein at 0.5 or 1.0% levels, failed to enhance growth or survival of adrenalectomized rats. However, liver glycogen concentration increased with the addition of methionine to the wheat gluten diet despite the constant hormonal dosage. Analyses of liver, kidney and testis protein or lipid failed to exhibit a methionine influence.

Lactalbumin is superior to casein in biological value when tested in normal rats but appears to be an inferior protein in adrenalectomized rats. Lactalbumin is characterized by a high sulfur amino acid content which may be undesirable. Consequently, the influence of a sulfur amino acid antagonist was tested by adding 0.5% ethionine to the lactalbumin diet. However, survival was not improved and a loss in body weight was observed. Furthermore, liver protein concentration decreased and liver lipid increased in ethionine fed adrenalectomized rats.

The administration of tryptophane, either subcutaneously or intraperitoneally, in 1 mg. daily dosages did not improve survival of adrenalectomized rats on 0.075 mg. of hormone and fed 20% casein.

The subnormal body weight gain by adrenalectomized rats on virtually any dose of cortisone acetate, despite

the maintenance of life, suggested the possible need for specific amino acids. There is some indication that lysine, histidine and tyrosine are excreted when cortisone acetate is administered. Adding these amino acids at a 0.3% level to the 20% casein diet, however, had a deleterious effect on survival and a body weight loss was recorded. Tissue protein and lipid analyses revealed that kidney and testis nitrogen was improved, but liver protein was not influenced. Supplementing the casein diet with 0.5% isoleucine, however, increased liver protein concentration.

Prefeeding 20% casein or protein-free diet for one week prior to adrenalectomy influenced the life-maintaining quality of cortisone acetate as well as the glyco-genic action on liver without altering body weight gain. Kidney and testis glycogen were not influenced.

Dietary protein level and type clearly influence the effectiveness of adrenal steroids, but little attention has been directed to caloric needs of adrenalectomized rats. Caloric restriction (50 per cent) of a 20% casein diet was obtained by lowering dietary carbohydrate or fat and replacing these components with cellu flour. Carbohydrate and fat reduced diets decreased survival and a body weight loss was recorded by carbohydrate reduction. Kidney glycogen was not influenced, but testis glycogen appeared to be somewhat altered by the fat reduced diet. Furthermore, diets low in fat allowed adrenalectomized rats to have more liver glycogen than pair-fed normal rats.

Microfilm \$2.00; Xerox \$6.20. 130 pages.

THE HISTOLOGICAL ANATOMY OF
RICTULARIA LUCIFUGUS DOUVRES, 1956
(NEMATODA: THELAZIIDAE)

(L. C. Card No. Mic 59-1898)

Frank William Douvres, Ph.D.
University of Maryland, 1958

Supervisor: Associate Professor, Dr. Joshua R. C. Brown

The anatomy of sexually mature, adult males and females of *Rictularia lucifugus* Douvres, 1956 a nematode infesting the small intestine of the little brown bat, *Myotis l. lucifugus* (LeConte, 1831), has been studied by general parasitological technique, en face and toto mount preparations. Standard histological methods described in texts of microtechnique were employed to enable the histological differentiation of the tissues, organs and body systems of this nematode.

There are described for both sexes of this nematode the gross anatomy and histology of the following: (1) the body wall and its outgrowths, the combs, spines, and caudal fans; (2) membranes, mesenteries, and coelomocytes present in the body cavity; (3) the excretory, digestive, and reproductive systems; (4) specialized muscles associated with the reproductive and digestive systems, and (5) in-part, the nervous system.

In general, the anatomy of *R. lucifugus* was similar to that of other nematodes.

The body wall consists of an external layer of cuticle, a middle layer of hypodermis, and an inner layer of somatic musculature. The cuticle is five-layered, externally marked by incomplete striations and in the female,

a specialized pebbled marking. The combs, spines, and male caudal fans are outgrowths of the cuticle. Each comb and spine is composed of two series of plates; while each fan is composed of a single series of plates. The hypodermis is composed of four multinucleated chords, a dorsal, a ventral and two laterals, which protrude into the body cavity; this tissue can not be demonstrated between the outer and inner body wall layers. The somatic musculature is polymyarian and coelomyarian.

The body cavity and organs are partially lined and covered, respectively, by pseudocoelomic membranes and mesenteries. Present in the female only, are two stelli-form coelomocytes.

The excretory system is of the ascaridid inverted U-type system and has only two nuclei associated with it.

The subdorsally oriented oral aperture is bordered by a cuticular perioral denticulated ridge. The buccal cavity is enclosed by a sclerotized capsule which forms three chambers, a buccal cavity, a buccal chute and buccal funnel. The esophagus is like other spirurids in its major divisions, however this organ terminates posteriorly in a totally muscular zone which is histologically different. The anterior muscular division is differentiated into anterior more muscular and posterior less muscular regions. Present in the esophagus is an esophago-sympathetic nervous system and, distributed throughout its three sectors, 30 radial nuclei and 12 marginal nuclei. The esophago-intestinal valve is composed of glandular tissue. The intestine of the females may be classed as myriocytous and anisocytous; that of the males as polycytous and isocytous.

The female reproductive system consists of two complete and functional genital tubes each of which is differentiated into an ovary, oviduct and uterus. The two uteri are continuous with a "Y-shaped" vagina. The reproductive system is of the didelphic and opisthodelphic type. The male reproductive system consists of a single genital tube which is differentiated into testis, seminal vesicle and vas deferens. The accessory sex organs associated with the male reproductive system consist of a somewhat triangular-shaped gubernaculum and unadorned, non-ornamented tubular left and right spicules, respectively.

There are associated with the digestive system specialized muscles, the somatostomatal muscles, somato-esophageal muscles, esophago-intestinal-valve muscle, somato-intestinal muscles, rectal muscles and depressor ani. There are also specialized muscles associated with the reproductive system, the vulvar dilators, a sphincter at the junction of the vagina and vulva, a sphincter at the distal end of the ovary, a sphincter at the junction of the seminal vesicle and vas deferens, a protractor and two retractors for each spicule and a protractor and two retractors for the gubernaculum.

Microfilm \$4.30; Xerox \$14.40. 335 pages.

POPULATION DYNAMICS OF ENGLISH SOLE
(*PAROPHRYS VETULUS*, GIRARD) IN PUGET
SOUND, WASHINGTON, WITH SPECIAL
REFERENCE TO THE PROBLEMS OF SAMPLING

(L. C. Card No. Mic 59-2199)

Sayed Zakaria El-Sayed, Ph.D.
University of Washington, 1959

Chairman: Dr. Richard Van Cleve

The investigation of an isolated population of the English sole (*Parophrys vetulus*) in the northern part of Puget Sound, Washington, was undertaken to determine the nature of the factors which control the productivity of such a stock of fish. The factors studied during this investigation were growth, natural mortality and fishing mortality.

It was deemed necessary at the outset of this investigation to determine the effect of the selective action of the trawl nets on sampling the population of *P. vetulus* and to study their effect on the growth and mortality rates of the fish. These studies showed that an increase in the mesh size of the cod-end caused an increase in the escapement of small fish and also affected the sex composition of the catch. As to the determination of the rate of growth, the study of the effect of mesh selection indicated that no one mesh size can adequately describe the growth rate of the fish and that a series of different cod-end meshes were necessary if a more representative growth curve of the population were to be obtained. The effect of mesh selection on the determination of the mortality rates indicated, that although the different nets used operate at different levels of selection, the regression lines of the catch curves had a common slope.

The interopercular bones, used in age determination of *P. vetulus*, gave more accurate and reliable estimates of age of fish than those obtained by the otolith bones. Seasonal and annual rates of growth of fish were determined, and variations of growth from year to year examined. Study of the available data on temperature and salinity gave no evidence that these physical factors affect the rate of growth of the fish. The length-weight relationship for the males and females were studied and the von Bertalanffy equation for growth in length and weight were derived. Comparison of the growth data collected by other authors from different areas with those of the present work showed that it is likely that these areas are inhabited by different stocks of *P. vetulus*.

The total mortality rates were obtained from the age-frequency curves, and no major fluctuation in the strength of the year classes was evident in the samples taken between 1953 and 1956 inclusive. The fishing mortality rates were determined from four tagging experiments in which 6366 tagged fish were released. The instantaneous rate of natural mortality was obtained by subtracting the instantaneous fishing mortality rate from the instantaneous total mortality rate. The unreasonable values thus obtained led to the exploration of other more meaningful methods, such as the calculation of the rate of exploitation given the rate of fishing mortality and trying different values of natural mortality rates.

A mathematical model of the *P. vetulus* fishery was constructed in order to assess the changes in the equilibrium yield corresponding to changes in fishing mortality and age of recruitment under the simplest conditions of

constant parameters. Examination of the yield-isopleths indicates that under the present circumstances the population of *P. vetulus* is apparently not overfished.

Caution was counseled in interpreting these results. The simple model described here was used because data concerning the nature of variations of the population parameters and their interactions, as well as measurement of their relations to changes in population density and in the environment, would require far more extensive and elaborate investigation than has been possible so far.

Microfilm \$2.75; Xerox \$9.60. 211 pages.

THE NATURAL HISTORY OF THE
ANGULAR-WINGED KATYDID
MICROCENTRUM RHOMBIFOLIUM (SAUSS.)

(L. C. Card No. Mic 59-2695)

Davison Greenawalt Grove, Ph.D.
Cornell University, 1959

The angular-winged katydid, *Microcentrum rhombifolium* (Sauss.), is the subject of these investigations. Most of the studies were made at Chambersburg, Pennsylvania, where the insect occurs as a native species, and specimens from that locality were used in further investigations at Ithaca, New York. The goal has been the utilization of one species of insect in a number of studies relating morphology, life history, behavior, and environment.

The insects are amenable to captivity and have been reared indoors and outdoors in cages made from ordinary orange crates. Eggs were forced to hatch indoors in winter, thus providing a year-round supply of active specimens. Outdoor studies show a correlation between temperature and initiation of hatching and a yearly variation in the length of the hatching period. Mating behavior and distribution of populations have also been studied under normal habitat conditions, but most other investigations were made on caged specimens.

The life history in Pennsylvania has been worked out. Studies on individual variation in size show significant differences related to diet. Rate of growth varies with environment and instar, regenerating powers are well-developed in young nymphs, and molting behavior follows a fixed pattern.

Range is related to climate, and habitat to the distribution of plants that provide proper food and concealment. Protective resemblance to vegetation is critical in many aspects of the insects' behavior and ecological relationships. Influences of light, gravity, and other members of the species are also important. Predation and parasitism are extensive and constitute important biological controls.

Reproductive behavior includes the transmission and reception of stridulatory calls by both sexes. Fecundity varies widely among individuals. Among caged pairs studied the frequency of mating has ranged from 1 to 11 times during the insects' lifespans, while individual females have deposited from 115 to 455 eggs. Oviposition occurs at frequent intervals (8 to 38 times for individuals studied) with the number of eggs produced in one set varying from 1 to 49 with a mean of 11.8 ± 1.83 , calculated on the basis of 251 sets. Highest viability is shown by eggs

deposited near the mid-point of a female's productive span. Evidence for parthenogenesis is lacking.

Microfilm \$2.00; Xerox \$6.60. 136 pages.

**A STUDY OF EXPERIMENTAL LEISHMANIASIS
IN THE MOUSE, MONGOLIAN GERBIL, HAMSTER,
WHITE RAT, COTTON RAT, AND CHINCHILLA**

(L. C. Card No. Mic 59-1816)

John Grun, Ph.D.
Rutgers University, 1959

Major Professor: Dr. Leslie A. Stauber

Attempts to select a more virulent strain of parasite (*Leishmania donovani*) for the mouse were unsuccessful. We were unable to find a more susceptible mouse strain in conjunction with this study. However, various techniques enhanced the course of infection in the mouse.

Variations in susceptibility to *Leishmania donovani* were noted in six species of laboratory animals. Inoculation of parasites was made intravascularly (i.c. or i.v.).

The number of parasites so injected in each case were similar and were such that they were relatively abundant in Giemsa-stained liver impression smears as soon as one hour after inoculation. The liver contains more than 90% of the parasites so inoculated; hence, the course of the infection is followed with relative ease. Within a species very consistent results are obtained by this method, making comparisons between species highly reliable.

The white rat was found to be the most resistant host, with parasite numbers falling virtually to zero in 23 days. At the other extreme are the cotton rat and the hamster. The hamster succumbs in 35-45 days with large numbers of parasites in its liver but the cotton rat survives even larger numbers for at least 196 days. Intermediate are the chinchilla, the gerbil (*Meriones unguiculatus*), and the mouse. In all three there is an initial increase of parasites, though at a lower rate than in the hamster and cotton rat, but in both the mouse and gerbil this is followed by a crisis with a fall of parasite numbers. No crisis occurs in the chinchilla; parasites continue to increase until death of the host supervenes.

Microfilm \$2.00; Xerox \$4.60. 86 pages.

**SOME ASPECTS OF THE HEMATOLOGY OF
TWO SPECIES OF CATFISH IN RELATION
TO THEIR HABITATS**

(L. C. Card No. Mic 59-1621)

Travis Glen Haws, Ph.D.
Purdue University, 1959

Major Professor: C. J. Goodnight

An investigation of some aspects of the hematology of two species of catfish was undertaken. The channel catfish, *Ictalurus punctatus* (Rafinesque), and the brown bullhead, *Ictalurus nebulosus* (LeSueur), were the species used.

A correlation was found between the habitat preference of the two species and their oxygen dissociation curves. The blood of the bullhead showed an oxygen dissociation curve of a very positive hyperbolic type which is remarkably similar to that of human myoglobin. The channel catfish curve was similar in shape but well shifted to the right. The bullhead, therefore, has the advantage over the channel catfish in water where the partial pressures of oxygen are low; however, after the oxygen is transported to the tissues it is given up more readily in the case of the channel catfish.

The effect of carbon dioxide upon the affinity of the blood for oxygen is much more pronounced in the case of the channel catfish than the bullhead which would suggest an additional advantage in the case of the bullhead over the channel catfish in waters relatively high in carbon dioxide content.

The effect of temperature on the oxygen carrying capacity of the two bloods shows the blood to be very similar at temperatures above 25°C. However, a lower temperature than 25°C. is of no apparent advantage to the bullhead, while the channel catfish blood shows a steady increase in ability to carry oxygen as the temperature of the water is lowered.

The similarity in concentration of hemoglobin for these two species of catfish together with their significantly different reactions to partial pressures of oxygen and carbon dioxide as well as temperature would suggest a biochemical difference in the hemoglobin molecule in the blood of these two species.

Carbon dioxide dissociation curves for these two fish indicated much similarity in their ability to transport this gas. In comparison with bloods of other vertebrates these two species are at the lower end of the scale.

Very little variation was found in the values for the specific gravity and pH for these two species.

A significant difference was noted between erythrocyte counts; the bullhead had a mean value of 1,217,740 cells per cubic millimeter compared with 2,162,500 cells for the channel catfish. However, the hemoglobin concentration and hematocrit are approximately the same which can be accounted for in the larger size of the bullhead erythrocytes. The shape of the erythrocytes was very much the same.

Analysis of water samples from several habitats showed river water to be high in dissolved oxygen and low in free carbon dioxide while the pond water samples showed just the opposite to be true.

Microfilm \$2.00; Xerox \$4.00. 73 pages.

**THE SPECIFICITY OF ACRIDIAN EGG PODS
AND EGGS WITH BIOLOGICAL NOTES**

(L. C. Card No. Mic 59-2486)

John Roy Hilliard, Jr., Ph.D.
The University of Texas, 1959

Supervisor: Dr. O. P. Breland

An investigation of the specificity of the egg pods and eggs of 65 species of grasshoppers was undertaken. From species confined in cages there were obtained 746 egg pods.

The structure of the egg pods and eggs of each species was described. The descriptions were supplemented with 63 line drawings and 74 photomicrographs revealing the internal organization of the egg pod and the sculpture patterns of the eggs. It was found that, in most cases, utilizing a combination of characteristics of the egg pod and chorion, the species of acridian depositing the egg pod can be determined.

In some instances evidences of systematic relationships were seen. A close systematic relationship between the genera *Aeoloplides* and *Hesperotettix*, which is indicated by adult morphology, is also reflected in general egg pod structure, arrangement of eggs, shape of eggs, and sculpturing of the chorion. Further study of additional material will be necessary to determine the relationships of higher taxonomic categories based upon sculpture patterns and egg pod characteristics.

Specimens from which eggs were obtained were confined to cages and offered a variety of native plants for food. Food selection was recorded for the first time for 21 species. Supplementary information was accumulated on the feeding behavior of 42 species.

A study of the biology of *Leptysma marginicollis* Serv., covering a period of 7 months, indicated an imaginal diapause for this species.

Microfilm \$4.35; Xerox \$14.60. 339 pages.

**A MORPHOLOGICAL STUDY OF THE ADULT
LACEWING, CHRYSOPA OCLATA SAY
(NEUROPTERA: CHRYSOPIDAE)**

(L. C. Card No. Mic 59-1912)

Joseph C. Hwang, Ph.D.
University of Maryland, 1958

Supervisor: Dr. William E. Bickley

This study was undertaken to obtain detailed information about the structure of *Chrysopa oculata* a widely distributed North American species, the larvae of which are important predators of aphids and other small insects. A thorough study of adult males and females was made. Gross anatomical dissections were supplemented by histological sections.

Each major body region with its appendages is considered separately. External and internal structures are described and illustrated.

Consideration is given to the alimentary canal, circulatory system, fat body and oenocytes, respiratory system, nervous system and sense organs, endocrine organs, and reproductive systems.

The musculature of the various parts of the body is compared with descriptions of the musculature of *Chrysopa plorabunda* Fitch a related Nearctic species studied by F. W. Miller (1933).

Information is provided on the repugnatorial glands which have openings on the sides of the prothorax, on the mandibular and salivary glands, on the anal glands which are seen on the exterior surface of the posterior intestine, and on the glands associated with the male and female reproductive systems. Some of these glands were incompletely described in other Neuroptera, and some

were unknown. The corpora allata and cardiaca are described, apparently for the first time in any neuropteroid insect.

Studies on the circulatory system include the recognition of two types of haemocytes, namely, the plasmatocytes and cystocytes.

The taxonomic value of the genital structures of neuropteroid insects has been recognized by a number of authors, but because of the number of different terms used to designate homologous structures a considerable amount of confusion exists. The terminology of Tjeder (1956) is accepted as the most practical for future work. Detailed explanations of genitalic structures and comparisons with related species are given. Use of these structures by taxonomists can proceed in a sound and reasonable manner with proper correlation of terminology in related families.

Microfilm \$2.15; Xerox \$7.60. 164 pages.

**ECOLOGICAL RELATIONSHIPS OF
PEROMYSCUS LEUCOPUS NOVEBORACENSIS
AND P. MANICULATUS GRACILIS IN
CENTRAL NEW YORK**

(L. C. Card No. Mic 59-2696)

Harold George Klein, Ph.D.
Cornell University, 1959

Supervisor: Dr. W. Robert Eadie

A study was made of the ecological relationships of the deer mice, *Peromyscus leucopus noveboracensis* and *P. maniculatus gracilis*, where both were present on three woodland areas near Ithaca, in central New York. Trapping grids with an interval of about 14 meters (45 feet) were laid out on the study areas. Mark-and-recapture studies were conducted during the summers of 1955 and 1956. Snap-trapping was done in the summer of 1957. The vegetation of each area was analyzed by the use of sample plots at trap stations. L. C. Cole's method of calculating a coefficient of interspecific association was used to measure the association between each species of mouse and various species of conspicuous plants. Behavior of captive mice was observed to determine whether interspecific antagonism was present. Water consumption of individuals of the two species was measured to determine whether interspecific differences existed. Petersen population estimates were made of each species for each trapping period, and population densities were calculated for each study area.

Results indicated that there was some ecological separation of the two species. *P. l. noveboracensis* was positively associated with plant species typical of climax vegetation of the Oak-Chestnut Forest region. These were *Quercus Prinus*, *Q. borealis*, *Q. alba*, *Rhododendron nudiflorum*, *Vaccinium angustifolium*, *Gaultheria procumbens* and *Pteridium aquilinum*. These species are part of developmental stages of vegetation of the Hemlock-White Pine-Northern Hardwoods Forest region, in which the study areas were located. *P. m. gracilis* was negatively associated with these species of the developmental vegetation. It was usually positively associated with plant species typical of the Hemlock-White Pine-Northern

Hardwoods Forest region. These were *Tsuga canadensis*, *Betula lutea*, *Acer pennsylvanicum*, *Polystichum acrostichoides*, *Dryopteris noveboracensis*, *D. spinulosa*, *D. marginalis*, *Fagus grandifolia* and *Acer nigrum* (includes all the sugar maples). *P. m. gracilis* was most positively associated with an edaphic climax association which is said to occur in habitats of dry soil and a cooler-than-normal micro-climate. Species in this association were *Tsuga canadensis*, *Betula lutea* and *Acer pennsylvanicum*. *P. l. noveboracensis* avoided these species and others characteristic of the Hemlock-White Pine-Northern Hardwoods region. However, it was at times positively associated with the climatic climax species, *Fagus grandifolia* and *Acer nigrum*. Conversely, *P. m. gracilis* was at times negatively associated with these plant species. These contradictory (plus additional neutral) coefficients of association between each species of *Peromyscus* and the climatic climax plant species appeared to indicate that *Fagus grandifolia*-*Acer nigrum* woodlands were places of ecological overlap between the species of *Peromyscus*. Population pressure within these species may have increased the amount of overlap.

Reasons for the ecological separation of the species were not brought out in the study. Information from various sources indicates that it is improbable that differential habitat selection occurred on the basis of soil moisture, humidity near the ground, amount of ground vegetation or presence of coniferous versus deciduous trees. Studies conducted in this area have shown that, during the summer months, surface soil temperatures in sugar maple-beech-yellow birch woodland were 3.3 to 3.9°C. (6 to 7°F.) lower than in chestnut oak woodland. Surface soil temperatures may have been a significant factor in differential habitat selection by *P. l. noveboracensis* and *P. m. gracilis*.

Microfilm \$2.00; Xerox \$5.20. 101 pages.

GENETICAL AND CYTOLOGICAL INVESTIGATIONS OF THE *DROSOPHILA DUNNI* SPECIES SUBGROUP

(L. C. Card No. Mic 59-2488)

Nikam Balaji Krishnamurthy, Ph.D.
The University of Texas, 1959

Supervisor: Dr. Wilson S. Stone

The *Drosophila dunni* species subgroup which belongs to the *cardini* species group of the genus *Drosophila* is interesting in several respects. It is restricted in distribution to Puerto Rico and to the islands of the Lesser Antilles. Each island population is distinct from the other island populations, in the nature and intensity of abdominal banding pattern. Two strains of the *dunni* subgroup were found to exhibit larval cannibalism. Cytological and genetical investigations carried out on these different populations indicate several points of interest. A salivary gland chromosome map of the strain from Puerto Rico was made to determine the inversion differences between strains. Cytologically the distinct populations of the *dunni* subgroup could be classed under four groups. Thus the populations from St. Thomas and Puerto Rico could be grouped under one cytologically distinct population;

another would include the Guadeloupe, St. Lucia and Barbados strains. The third population includes only the distinct population from Martinique which differs from all others in possessing a heterozygous inversion, 2RB. The fourth group includes the island populations from St. Vincent and Grenada. Additional heterochromatin of different amounts has been found in the strains from St. Thomas and Puerto Rico. Cytological comparisons of the *dunni* subgroup and strains of *Drosophila acutilabella* were made, indicating that the St. Vincent *dunni* differed from the Jamaican strain of *Drosophila acutilabella* by a single median inversion in the x chromosome. About twenty-six short nonpairing regions, as well as differences in chromatin bands at the distal ends of the salivary chromosomes of the hybrid between *acutilabella* and *dunni* were observed. Only three major inversions have become established during the evolution of the *dunni* subgroup. The analysis of the intraspecific and interspecific differences in the *dunni* subgroup and the pairing of homologous chromosomes in the salivary nuclei indicate that the degree of pairing is usually related to distance. The strains which are closer to each other were observed to show better pairing relationships than with the distant strains. Genetic tests conducted indicate a correlation between the degree of cross fertility and geographic origin of the strain. Genetically the strain from Guadeloupe is crossfertilile with all the other strains of the *dunni* subgroup and hence it or a related strain can be regarded as the most nearly primitive member of the subgroup. Geographic isolation and a combination of reproductive isolating mechanisms were observed within the subgroup.

Microfilm \$2.00; Xerox \$5.40. 106 pages.

SOME FACTORS INFLUENCING THE PERSISTENCE AND INSECTICIDAL EFFICIENCY OF FIVE CHLORINATED HYDROCARBON INSECTICIDES

(L. C. Card No. Mic 59-2035)

John Warren Matteson, Ph.D.
University of Illinois, 1959

During the mid-1940's, several chlorinated hydrocarbon compounds were found to possess remarkable insecticidal properties. Federal and state agencies and producers of insecticides started projects after these compounds were in widespread use which were generally designed to furnish information needed for the establishment of safe residue limits for these insecticides. Little of the research to date has been designed to evaluate the factors which control the persistence of the insecticides. The factors under consideration in this thesis are temperature, wind, sunlight, and the type of formulation employed. Information pertaining to these factors and their effects on insecticides would be helpful in predicting insecticide losses according to prevailing climatic conditions.

A series of experiments were run in the field and in the laboratory to determine the effects of temperature, wind, sunlight and the type of formulation on the persistence of the insecticides DDT, methoxychlor, dieldrin, aldrin, and heptachlor.

The experimentation demonstrated that the length of residual life of all five insecticides is shortened, at least

to some extent, by exposure to temperature, sunlight, and wind. Methoxychlor is relatively resistant to the effects of increased temperatures; however, it is very susceptible to loss by the action of sunlight. DDT is less affected by sunlight, but is much more affected by increased temperature and wind than is methoxychlor. Aldrin, dieldrin and heptachlor are affected moderately by all three factors. The rate of loss of the insecticides is dependent, at least in part, by the nature of their deposit and by their vapor pressures.

The type of formulation used affects the amount of insecticide deposited and its persistence in the field. Standard No. 9 oil allows more initial deposit and longer persistence than does the emulsion or suspension used. The suspension has the least initial deposit and shortest residual life of the formulations tested. The type of chlorinated hydrocarbon insecticide used does not affect the order of persistence of the various insecticidal formulations.

The efficiency of an insecticide is correlated with its availability as well as its toxicity to an insect. Chinch bugs, exposed to insecticides deposited on filter paper, are the most susceptible to dieldrin; aldrin and heptachlor display slightly less toxicity by contact. Methoxychlor and DDT are relatively non-toxic to chinch bugs by contact.

The five chlorinated hydrocarbon insecticides tested, arranged in order of increasing toxicity by contact to house flies are methoxychlor, DDT, dieldrin, aldrin, and heptachlor. Microfilm \$2.00; Xerox \$3.00. 60 pages.

THE EFFECTS OF AGE, NUTRITION, SPECIES AND HORMONES ON THE BIOCHEMICAL COMPOSITION OF THE TESTIS

(L. C. Card No. Mic 59-1820)

Shirley Ann McCormack, Ph.D.
Rutgers University, 1959

Major Professor: Dr. James H. Leathem

In order to form a reasonable basis for the continuing use of the sex hormones in the treatment of reproductive problems, the biochemical composition of the normal testis as well as deviations from the normal pattern should be studied. The effects of age, administration of estrogen and/or testosterone, 72 hours' starvation with or without testosterone, and level of dietary protein on the testes and seminal vesicles of mice and hamsters have been studied by means of biochemical determinations of the glycogen, protein and water content of these organs. Glycogen was determined by means of anthrone reagent, protein by means of the micro-Kjeldahl method, and water by drying to constant weight at 95°C. Histochemical observations have served as an adjunct to the biochemical determinations and effects on organ weights have been noted. The following conclusions have been drawn regarding the response of mice and hamster testes and seminal vesicles to the various experimental procedures used:

1. No suggestions of reduced testis function was found in one-year old mice and hamsters.

2. In spite of changes induced in protein and glycogen content, the mouse testis maintains a constant water concentration of approximately 85 per cent.
3. Hamster testis water concentration is also approximately 85 per cent but can be reduced by estrogen.
4. In spite of the apparent resistance of the mouse testis to estrogen damage as assessed by testis weight loss, estrogen damages the mouse testis even at a level of 1 µg administered daily for 21 days as is evidenced by a loss of testis glycogen and protein and by corresponding losses in the seminal vesicle.
5. Testosterone has no significant effect on mouse testis and seminal vesicle protein but increases glycogen in these organs.
6. Testosterone, in dosages up to 1 mg, has no significant effect on the water, protein or glycogen content of hamster testis or seminal vesicle.
7. The simultaneous administration of 1 mg of testosterone and 25 µg of estradiol benzoate to the mouse results in the nullification of most of the effects of estrogen on the testis while those of testosterone on the seminal vesicle continue to manifest themselves.
8. Two-hundred micrograms of testosterone propionate administered simultaneously with 35 µg of estradiol benzoate to the hamster caused an increase in seminal vesicle glycogen, the only treatment which was able to accomplish this.
9. Although starvation alone in the mouse has little effect on the testis, it will prevent the rise in testis glycogen caused by 250 µg of testosterone propionate but not the rise in seminal vesicle glycogen which follows testosterone.
10. Starvation causes a loss in hamster testis and seminal vesicle glycogen. This loss can be overcome by concomitant administration of 1 mg of testosterone propionate though not by 500 or 200 µg of testosterone propionate.
11. A diet low or lacking in protein causes retardation of testis and seminal vesicle growth of immature mice and depresses levels of total testis and seminal vesicle protein and glycogen, but the concentration of water, protein and glycogen in these organs remains normal.

Microfilm \$2.00; Xerox \$5.80. 118 pages.

THE EFFECT OF ENVIRONMENTAL
TEMPERATURE ON THE ENERGY METABOLISM
OF THE RED-BACKED MOUSE,
CLETHRIONOMYS GAPPERI (VIGORS)

(L. C. Card No. Mic 59-2048)

James Frederic Opsahl, Ph.D.
University of Illinois, 1959

The existence energy of red-backed mice, *Clethrionomys gapperi galei* and *C. g. gapperi*, was determined at 3°C, 13°C, and 26°C under photoperiods of 9.25 and 15 hours. The determinations were made by subtracting the energy loss in the feces from the gross energy intake of the food after the animals stabilized weight under each set of experimental conditions. Energy of fat metabolized or stored was also considered for animals that did not establish weight equilibrium.

At a given temperature, the existence energy per gram body weight per day decreased with increasing body weight of adult mice. With lowering air temperature, existence energy requirements increased .029 KCal/gram/day/1°C from a low of .43 KCal/gram/day at 26°C. There were no significant differences between existence energy levels at 9.25 and 15 hour photoperiods, nor between mice captured the year before and the year after a crash in the microtine population cycle.

Most mice placed at 3°C lost weight during an initial period but eventually became stabilized at a lower level. The limit to the amount of weight loss that could be tolerated was between 19 and 22 per cent of the initial weight, and at the rate of no more than 0.8 per cent per day. This, in terms of energy resources, indicated 7.8 per cent/day of existence energy as the greatest amount that could be supplied from fat stores. At 26°C weight changes were inconsistent.

The mortality of 45 percent of the mice at 3°C indicated that this was near the lower limit of tolerance for existence. Total mortality at 38°C showed that the upper limit was somewhat below this temperature. Although air temperature extremes over the geographic range of *C. gapperi* may exceed these limits of tolerance, temperatures of the microclimate of the forest floor occupied by these mice remain within the tolerable limits. Modified activity patterns during periods of extreme temperatures within the range of tolerance also result in avoidance of these temperatures and reduction of energy expense.

The amount of productive energy available above that required for existence at each temperature was calculated. It was at a maximum of .75 KCal/gram/day at 26°C and declined to zero at 0°C where it was estimated that all available energy was required for existence. One mouse that had access to an activity wheel used part of this productive energy to run 10.56 miles per day using .023 KCal/gram/mile.

The data on the two subspecies used in this study and similar data on other subspecies reported in literature indicated no important differences between subspecies.

Microfilm \$2.00; Xerox \$3.00. 45 pages.

CYTOPLASMIC STRUCTURE AND
CYTOCHEMISTRY OF TWO HELIOZOANS:
ACTINOSPHAERIUM EICHHORNII AND
ACTINOPHRYS SOL

(L. C. Card No. Mic 59-2315)

Edward Ritter, Ph.D.
The Ohio State University, 1953

The cytoplasmic structure of the heliozoans *Actinosphaerium eichhornii* and *Actinophrys sol* was studied by means of vital stains, classical cytological techniques, cytochemical methods, and phase contrast microscopy.

The differences between these two species are found to lie in dissimilar arrangement of structures and, in at least one case, in the lack of a given component, rather than in any detectable chemical difference of structures possessed in common.

The cytoplasmic components and inclusions studied were: the cell membrane, the axial filaments, the Golgi granules, the excretion granules, the mitochondria, the contractile vacuoles, the permanent vacuoles, the food vacuoles, fat droplets, and the cytoplasmic ground substance, or hyaloplasm. No crystals and no bacteria or other symbionts were found at any time.

The cell membrane of both species is extremely thin, and apparently of the nature of a plasma membrane. Despite this thinness, it was possible, in both species, to demonstrate a neutral mucopolysaccharide in it. The membrane of *Actinosphaerium eichhornii* was found to be permeable to vital stains; the membrane of the race or variety of *Actinophrys sol* here studied was not.

The latter organism was first found in very acid waters (pH 2.5) and had to be cultured in a similarly acid medium.

The axial filaments of the axopodia of both species also were shown to contain a neutral mucopolysaccharide. It was found that the cell membrane is capable of dissolving these filaments on contact.

Under phase contrast, the axial filaments appear as solid, homogeneous structures. However, it was seen in observing newly forming filaments that each is formed from several fibrils which fuse. Both heat and mechanical pressure cause the dissolution of the filaments—indicating that the latter are in a gel state rather than solid.

The granules designated as Golgi granules, found chiefly in the axopodia and the cortical layer in both species, are osmiophilic and are composed of a lipoprotein material. In *Actinosphaerium* these granules stain with neutral red. It seems probable from the staining and cytochemical results obtained that the Golgi granules correspond to the spherical refractive bodies of amoebas and represent the Golgi element of other animals.

The so-called excretory granules are found in the ectoplasm and in the permanent vacuoles of *Actinosphaerium*, but are not present in *Actinophrys*. These granules appear to be composed primarily of a neutral mucopolysaccharide. They do not stain with neutral red and are not reduced by osmium tetroxide. They are soluble in certain acids. The number of excretion granules in *Actinosphaerium* apparently varies with the state of nutrition. It is uncertain whether they are actually excretory in nature or represent reserve material.

The mitochondria of both species are found predominantly in the endoplasm. In *Actinosphaerium* they stain green with Janus green B, although not consistently; no

other components are colored green by this stain. In both species they are composed of lipoprotein material and stain in iron-hematoxylin after Benda's fixative and in acid fuchsin after Regaud's fixative, as do the mitochondria of other Protozoa and of metazoa.

The distribution of mitochondria in the endoplasm and especially around the food vacuoles would seem to indicate that they are connected with digestion. However, at no time could they be demonstrated within the food vacuoles.

The number of contractile vacuoles present in these two heliozoans varies from 2 to 14 in *Actinosphaerium* and from 1 to 2 in *Actinophrys*. There does not appear to be any definite rhythm in the pulsation of any given vacuole. The contractile vacuoles in both species are surrounded by Golgi granules rather than by mitochondria as in the amoebas.

The non-contractile vacuoles are here called permanent vacuoles because of their similarity to the permanent vacuoles found in *Mayorella bigemma* and *Chaos chaos*.

Ingestion, digestion, and egestion of food material were observed in both species. The breakdown of large food vacuoles into smaller ones, as reported in amoebas, does not occur in these heliozoans.

Droplets of neutral fat were found in the cytoplasm of both species. Fat was present in the food vacuoles, but its nature could not be determined.

The cytoplasmic ground substance or hyaloplasm of both species was found to contain plasmalogen, sulfhydryl, and ribonucleic acid. The latter was also present in the nuclei, along with desoxyribonucleic acid. None of these compounds was found in any of the other cytoplasmic components.

Glycogen was found rather diffusely spread in the hyaloplasm of *Actinosphaerium*, but could not be demonstrated in *Actinophrys*.

The present study has shown that in their finer structure and cytochemistry *Actinosphaerium eichhorni* and *Actinophrys sol* are remarkably alike, despite the gross structural differences between the two genera. Similar results have been reported by various authors for several species of amoebas and for many types of cells in higher animals. Thus the basic similarity of cell organization of living organisms, whether they are the "simple" Protozoa or the "complex" metazoa, is again illustrated, and one more bit of evidence is added in support of evolutionary concepts. Microfilm \$2.00; Xerox \$5.00. 97 pages.

Abstract published by special arrangement with The Ohio State University.

**A MORPHOLOGICAL STUDY OF THE
RESPIRATORY HORNS ASSOCIATED WITH
THE PUPARIA OF SOME DIPTERA,
ESPECIALLY OPHYRA ANESCENS (WIED.)**

(L. C. Card No. Mic 59-2317)

Leon Ramon Roddy, Ph.D.
The Ohio State University, 1953

The study concerns the respiratory horns of three species of Diptera. This term is the common name given to a pair of pronglike structures which occur on the dorso-

lateral aspects of the cephalic half of a number of pupae and puparia of Diptera, especially among Cyclorrhapha. De Meijere¹ made the first systematic attempt to describe the structure of the respiratory horns in various families of Diptera, drawing information both from his own observation and from the scattered descriptions in literature on the subject. Many interesting examples of respiratory horns in pupae have been described, figuring in several papers dealing with the morphology of larvae and pupae of Diptera. The figures in these papers give a clear idea of the great variations in size, shape, and structure of the respiratory horns which are often described as prothoracic horns, trumpets, spiracles, siphons, or gills. Their size varies from short, sessile, and hardly perceptible to long and distinctly prominent projections in some pupae.

The study was restricted to the puparia of *Ophyra anescens* (Wied.), *Lucilia sericata* (Meig.), and *Musca domestica* (Linn.); however, the greater part of the information was ascertained from *Ophyra anescens* (Wied.) The species named are closely related in that they belong to the same large group (Calyptate Muscoidea), yet the larvae and puparia are distinctly different, as are the respiratory horns that appear on the puparia of these species.

The purpose of the study was to determine the following facts regarding the respiratory horns: structure and development, time of appearance, size, location, the effects of temperature and humidity on their development, their function in respiration, and the relation between the size of the horns and the respiration rate.

The method used in the rearing of *Ophyra anescens* (Wied.) was a modification of the technique used by Dr. F. M. Snyder of the Chemical Corps Laboratory at Army Chemical Center, Maryland.

The larval medium consisted of whole milk powder (Klim)—200 g., Brewers' yeast (Fleischman)—200 g., bacto-agar—15 g. and tap water (boiling)—2 l. The dried ingredients are added slowly to the boiling water and stirred continuously to insure thorough mixing. When the medium is cooled it is stored in sealed containers and kept in a refrigerator until needed.

The method used to rear *Musca domestica* (Linn) was the standard technique specified by the *Soap Blue Book*² for use in connection with the Peet-Grady tests for household fly sprays.

The method used in the rearing of *Lucilia sericata* (Meig) was essentially the same as the technique used by Frings³.

A method similar to the one used by Robertson⁴ was employed to obtain puparia of a known age. When a larva ceases to feed and begins to shorten in length, it is removed from the culture medium and transferred to a small Petri dish. When there is no further movement by the larva, the time is checked and recorded on the Petri dish. The lack of movement and shortening of the body is interpreted as the beginning of the puparial stage. Thus the age of the puparium is calculated in hours from the beginning pupariation until the adults emerge.

As a means of measuring the respiration rate in the various stages of pupal development, a small differential microrespirometer manufactured by the Microchemical Specialties Company, Berkeley, California, was used.

The pupae of the Cyclorrhaphous Diptera are always enclosed within the last larval skin, sclerotized into a hard and dark case known as a puparium. In the majority of the calyptates the pupae has a pair of prothoracic

spiracles which are enclosed within the puparium and are known as internal spiracles. Each internal spiracle is composed of a felt chamber covered with numerous papillae. In the majority of the calyptrates the felt chamber of each prothoracic spiracle of the pupae is drawn out into a sclerotized horn which projects through a small circular aperture in the wall of the puparium on the first abdominal segment.

In *Ophyra anescens* (Wied.) the horn apparently arises as an outgrowth from the prothoracic imaginal disk of the developing imago. Fully developed horns at first lie parallel to the length of the body; after protrusion they are perpendicular to the body. About 18 hours after pupariation the pupa contracts, which is apparently due to the evagination of the imaginal disks in the head. This contraction of the pupae brings the horns backward so that their tips lie directly beneath the small circular apertures in the wall of the puparium. Backward and forward movements of the pupa forces the horns through the two fragile spots in the wall of the puparium. The horns are completely developed and extruded from the puparium 28 to 30 hours after pupariation.

A summary of the results from the study of the respiratory horns in the three species studied follows. (1) The time of the emergence of the respiratory horns is somewhat constant in the puparia of *Ophyra anescens* and *Musca domestica*, but quite variable in *Lucilia sericata*. (2) The location of the horns is the same for each species—the conjunctiva between the fifth and sixth visible segments, on the dorsal side. (3) There is considerable difference in the size of the horns—largest in *O. anescens*, intermediate in *L. sericata*, and smallest in *M. domestica*. (4) The results obtained from spiracular plugging of the tracheal system, dissections, and dye penetration of the tracheal system indicate that the respiratory horns are the sole means of pupal respiration. (5) The size and structure of the respiratory horns has no influence on the respiration rate in the developing imago; results show that although the respiratory horns found in the puparia of *O. anescens* are much larger than those found in the other two species, the respiration rate is less. (6) It appears that fluctuating temperatures rather than humidity effects the development of the respiratory horns, especially in *O. anescens*.

Microfilm \$2.00; Xerox \$3.00. 46 pages.

1. Meijere, de, J.C.H. "Ueber Die Prothorakalstigmen der Dipterenpuppen," *Zool. Jb. (Morph.)*, 15 (1903), pp. 623-692.

2. Blue Book: *Soap and Sanitary Chemicals*. New York: 1953, pp. 223-225.

3. Frings, H. "Rearing Blowflies in the Laboratory," *Jour. Econ. Ent.*, 34 (1941), p. 317.

4. Robertson, C. W. "The Metamorphosis of *Drosophila melanogaster*, Including an Accurately Times Account of the Principle Changes in Morphology," *Journ. Morph.*, 59 (1936), pp. 351-399.

Abstract published by special arrangement with The Ohio State University.

THE EFFECTS OF PRESERVATIVES ON ANTIGENS AS INDICATED BY ANTIGEN-ANTIBODY REACTIONS

(L. C. Card No. Mic 59-1826)

Calvin Albert Saravis, Ph.D.
Rutgers University, 1959

Major Professor: Dr. Ralph J. DeFalco

The sera from beef, man, chicken, and sheep were treated with various preservatives and were either stored for an extended period of time, or incubated at 37° C. for a month or more. These antigens were tested for serological activity with antisera made to the native proteins. Also tested were preserved milk and egg-albumin.

Various preservatives were used. These included chemical additives such as phenol (final concentration 0.2%), formaldehyde (final concentration 0.2%), glycerine (final concentration 50%), and various concentrations of sodium azide and merthiolate.

The serological tests used were the precipitin reaction and heterohemagglutination. The precipitin reactions of the antigens were observed and measured using the Libby photorefractometer. This instrument, utilizing a photoelectric cell, directly measures the amount of turbidity that develops over the complete reaction range of the antigen.

Electrophoretic analyses of all the antigens were concomitantly made with the precipitin tests to determine the effects of the preservatives and storage on the serum components.

When beef sera were frozen, excellent precipitin reactions were obtained. Also outstanding were the facts that:

- (1) the Seitz filtration of both the serum and preservative was necessary when formaldehyde was used.
- (2) a concentration of 0.3% sodium azide was effective as a preservative of unsterile sera stored at room temperature.
- (3) glycerine was effective as a general preservative.
- (4) a merthiolate concentration of 1:2,500 was satisfactory for the storage of unsterile sera.
- (5) at a concentration of 0.2%, phenol was effective as a preservative. At higher concentrations there were decreased precipitin reactions.
- (6) the inactivation of sera by heating them at 56° C. for 30 minutes had little effect on the precipitin reaction.

The precipitin reactions of preserved human serum antigens showed that:

- (1) the addition of preservatives might cause decreased precipitin reactions.
- (2) while additives such as sodium azide and glycerine were generally effective as preservatives, phenol, formaldehyde, and possibly merthiolate were ineffective as preservatives of human sera.

The precipitin reactions of the preserved ovine serum antigens showed that all of the preservatives except formaldehyde were effective in protecting the serological activities of the sera.

Preserved serum antigens of chicken origin gave reactions which indicated that merthiolate, glycerine, and formaldehyde were excellent preservatives of the fowl antigens. It was also found that the reaction of the serum with sodium azide formed an inactive complex that gave a low precipitin reaction.

Precipitin reactions of preserved egg-albumin antigens showed that while an unpreserved antigen gave a reaction indicative of denaturation, all of the preservative were effective in preventing large changes in serological reactivities.

None of the preserved milk antigens except formolized milk gave a fair precipitin reaction.

Any one of the following preservatives is recommended for field collection of sera:

Glycerine, 50%
0.3% Sodium Azide
1:2,500 Merthiolate
56° C./30 minutes

It was found that several of the preservatives inhibited the naturally occurring heterohemagglutination of human red blood cells by the sera of the various other species studied here. In addition, where the manifestation of agglutination was lost, a Coombs test frequently showed antigen-antibody interaction.

Microfilm \$2.00; Xerox \$5.80. 119 pages.

THE STIMULATORY EFFECT OF VARIOUS FOODS ON PROTEOLYTIC DIGESTION IN ADULT *Aedes Aegypti* LINN

(L. C. Card No. Mic 59-2319)

George Franklin Shambaugh, Ph.D.
The Ohio State University, 1953

Results of previous studies which concluded that the stimulation of proteolytic enzymes in the midgut of *Aedes aegypti* is secretagogue in nature served as a basis for the research. The technique of feeding adult female mosquitoes blood substitute solutions through warmed membranes is described.

A series of mosquito injection tests supports the previously proposed theory of protease stimulation by secretagogues. Tests for conceivable zymogens present in the midgut stimulated by a kinase carried in the blood (similar to the trypsinogen-enterokinase relationship of vertebrates) were negative. Various blood fractions were tested for possible secretagogue influences. In order for blood substitute solutions to be dispatched primarily to the midgut where protease elaboration is confined, it was expedient to mix them with thrice-washed erythrocytes.

A residual value of protease activity is given for unfed, or blood-starved, individuals. The effect of cellular proteins in a relatively inert medium (sheep erythrocytes in physiological saline) is somewhat greater than the residual value. Both the dialyzable and nondialyzable portions of blood were tested. The dialyzable portion mixed with erythrocytes was one and one-half times as effective in enzyme stimulation as the mixture of erythrocytes in saline. This would indicate a weak dialyzable stimulatory factor in blood plasma. However, the non-

dialyzable plasma proteins and erythrocytes resuspended in saline intensified enzyme activity to a height four times that of erythrocytes in saline. Evidently the more important stimulatory factors are in the nondialyzable plasma fractions.

The effect of three plasma protein fractions at a concentration of 0.6 per cent was tested. Fraction I (fibrinogen), normally 6 per cent of plasma proteins, stimulated a secretion of enzymes comparable to that of the plasma dialyzate. Fraction V (albumin), normally 48 per cent of plasma proteins, provided an increase in activity above that of fibrinogen. Fraction II (gamma-globulin), normally 6 per cent of plasma proteins, stimulated a secretion greater than the sum of the fractions I and V. Enzymatic response to the mixture of these three fractions of plasma proteins was greater than to any one fraction, but was not greater than the summed effect of the separate fractions (in excess of the value for erythrocytes alone).

Through a series of experiments utilizing individual weights, it was possible to discover a positive correlation between the amount of blood ingested by female mosquitoes and the subsequent protease activity of their midguts. This would lead to the conclusion that an increase in ingested blood increases the amount of the protein substrate for midgut proteases.

Discussions of the effect of the blood fractions fed to mosquitoes upon the degree of oviposition or infectivity with malarial parasites are given. From this discussion intimately linking malarial infection and protease elaboration separately with plasma proteins, it is possible to suggest a stronger interaction between processes affecting digestion and infectivity than supposed earlier.

Microfilm \$2.00; Xerox \$3.00. 45 pages.

Abstract published by special arrangement with The Ohio State University.

DIGENETIC TREMATODES OF MARINE FISHES OF PUERTO RICO, A MONOGRAPHIC STUDY

(L. C. Card No. Mic 59-1643)

Ather Husain Siddiqi, Ph.D.
Purdue University, 1959

Major Professor: R. M. Cable

The collection of digenetic trematodes of marine fishes of Puerto Rico includes 97 species representing 58 genera belonging to 18 families. Thirty four species and 6 genera are new. The family Aspidogastridae is represented by a single new species of the genus *Cotylogaster* reported for the first time from a marine host in the Western Hemisphere. Each of the families Haplospilnidae and Monorchidae are represented by 5 species, of which 2 haplospilnids and 1 monorchid are new; as are also 2 species of the family Bucephalidae. The genus *Zoogonus* is represented by two new species, *Z. longicecus* and *Z. malacanthi*, both of which have long ceca but are similar to the genus in all other respects. A new genus *Infundibulostomum* represented by a single species, *I. spinatum*, has been classified in the Fellodistomatidae. It is interesting to note that this species has a single testis, but

lacks the characteristic structure of the metraterm common to monorchids.

It is of further interest that the family Microphallidae is represented by 2 new species, *Carneophallus lactophrysi* and *Megalophallus diodontis*. Both genera have been reported from birds or mammals only. This is the first record of microphallids occurring in marine fishes.

It is necessary to redefine the family Waretrematidae to include 2 new genera *Neomegasolena*, which lacks a hermaphroditic sac, and *Allomegasolena*, which is very similar to the genus *Megasolena*, but differs in several respects. Both of the new genera have two testes, and the cuticle is spinose. *Neomegasolena* is represented by a single species, *N. chaetodipteri*, and *Allomegasolena* by two species, *A. spinosa* and *A. attenuata*.

The families Microscaphiidae and Gorgoderidae are each represented by a single species, and 3 are reported for each of the families, Cryptogonimidae, Megaperidae and Opistholebetidae. Five previously known species belonging to the Acanthocolpidae are described, 4 in the genus *Stephanostomum* and *Manteria brachydera*, previously known only from Pacific waters.

The families Opecoelidae and Lepocreadiidae are especially well represented, the Opecoelidae by 22 species and the Lepocreadiidae by 21 species. A new opecoelid genus *Pinguitrema* is erected to include *P. lobata*, which shows characteristics of both the genus *Pycnadena* and members of the family Opistholebetidae. The genus *Neohelicometra* is erected to contain *N. cablei* which has separate ani, but otherwise resembles the genera *Helicometra* and *Helicometrina* in having eggs with unipolar filaments. Of three species of *Hamacreadium*, two are described as new: *H. lintoni* and *H. longisaccum*.

Among the Lepocreadiidae, a new genus *Neapocreadium* has been erected to contain *N. angustum*, *N. coili*, and *N. bravoii*, all described as species of *Apocreadium* by Sogandares-Bernal (in press). Four new species are described in the genus *Neolepidapedon* and are reported for the first time from Atlantic waters. The genus *Lepidapedon* is represented by a single new species *L. holocentri*. Microfilm \$2.85; Xerox \$9.80. 217 pages.

STUDIES ON MARINE FISH TREMATODES FROM THE GULF OF PANAMA AND BIMINI, BRITISH WEST INDIES

(L. C. Card No. Mic 59-1792)

Franklin Sogandares-Bernal, Ph.D.
The University of Nebraska, 1958

Adviser: Professor H. W. Manter

During the summers of 1956 and 1957 the author collected trematode parasites from fishes in the Gulf of Panama (1956) and at Bimini, B.W.I. (1957). In Panama, 234 specimens of 115 species of fishes were examined; at Bimini, 250 specimens of 109 species; a total of 480 individuals of 222 species.

Eighty-six species of digenetic trematodes were collected and studied. Thirty-one of these were from Panama, sixty from Bimini. Five species occurred in both regions. Twenty-nine new host records are noted.

Two new genera and seventeen new species are named. These are distributed in eight families.

The names of ten species and one genus are considered synonyms of forms previously named.

Observations on the ecology of these trematodes included notation of the exact location of the parasites in the digestive tract, and, in some cases, measurement of the pH (alkalinity or acidity) of these locations. The pH was found to vary considerably even in the same region of different individuals, depending chiefly on recency of feeding.

The Digenea of Bimini are very similar to those known from Tortugas, Florida where they have been extensively studied. However, the known resemblance of those of Tortugas to those of the American Pacific is increased by 5 species found in both oceans, making an impressive total of 41 species. Microfilm \$2.80; Xerox \$9.60. 214 pages.

NEUROSECRETION AND ITS PHYSIOLOGICAL CORRELATION IN HYPOPITUITARY HEREDITARY DWARF MICE

(L. C. Card No. Mic 59-1988)

Vincent P. Stouter, Ph.D.
The University of Buffalo, 1959

By use of the Gomori chrom-alum hematoxylin staining technique, neurosecretory deposits in the hypothalamo-neurohypophyseal system of dwarf mice are shown to be more prominent than in normal young mice with body dimensions similar to dwarfs (size-controls) and in normal adult mice of ages comparable to dwarfs (age-controls). The neurosecretory content of the supraoptic and paraventricular nuclei of dwarfs is considerably more dense than in normal size-controls and age-controls.

The infundibular process of severely saline-dehydrated or water-deprived dwarfs sacrificed on the point of death shows a residuum of neurosecretory material which is not observed in similarly treated size-controls. The explanation of this finding is uncertain. It is suggested that the more prominent neurosecretory deposits in the hypothalamo-neurohypophyseal systems of dwarfs and the infundibular neurosecretory residuum in severely dehydrated dwarfs is the resultant of a less efficient release mechanism at the neurohypophyseal nerve terminals.

The administration of mildly hydrating or severely hydrating water loads to dwarfs by stomach tube does not increase the amounts of hypothalamo-neurohypophyseal neurosecretory material. Single doses of adrenal cortical extract (ACE) or multiple doses, given in the period of 2 - 3 hours, do not appreciably alter the neurosecretory content of the infundibular process. Pitressin administered in a similar fashion is also shown to have little effect in the alteration of the infundibular neurosecretory content.

The daily water requirements and urine outputs of dwarfs are not materially different from size-controls. Dehydration by water-deprivation and 2% saline administration is tolerated by dwarfs and normals to approximately the same extent, i. e., 7 and 10 days, respectively. Dwarfs are more susceptible to water intoxication than are normal size-controls.

Water intoxication can be prevented in both dwarfs and size-controls by the simultaneous administration of ACE along with successive water doses. Susceptibility to water intoxication is increased proportionally in dwarfs and size-controls by the administration of pitressin.

Microfilm \$2.00; Xerox \$5.20. 101 pages.

STUDIES ON THE DEVELOPMENT AND APPLICATION OF A MODIFIED HEMAGGLUTINATION PROCEDURE

(L. C. Card No. Mic 59-1831)

Helen R. Strausser, Ph.D.
Rutgers University, 1959

Major Professor: Dr. Ralph J. DeFalco

This thesis is concerned with the development of a modified hemagglutination technique based on the Boyden method of treating sheep erythrocytes with tannic acid thus rendering them capable of adsorbing protein molecules from solution. Erythrocytes which have been coated in this manner are agglutinated by high dilutions of antisera directed against the protein molecules. To facilitate the performance of the Boyden procedure, and to overcome the occasional lack of reproducibility due to variations in different samples of erythrocytes, as well as to improve

the stability of the erythrocytes for test and storage purposes, a method by which the cells are preserved with formalin has been used. Formalin preserved erythrocytes of various species have been stable and serologically reactive for periods up to twenty-one months at the time of this writing. Storage of the entire antigen coated preserved cell complex has been accomplished by the use of additional preservatives or freezing of the coated preserved cells.

The modified test has been applied to the determination of the specificity of anti-beef and anti-sheep sera when tested with homologous and heterologous antigens and similar determinations with anti-beef albumin and anti-beef globulin sera have been performed. In addition, the modified hemagglutination test has been used to detect human antibodies to tuberculin and egg albumin and rabbit antibodies to chorionic gonadotrophin. Inhibition of the hemagglutination reaction has been used to determine the specificity of the antisera as well as to detect the presence of the antigen, e.g. detection of the presence of chorionic gonadotrophin in pregnancy urine.

Advantages and disadvantages of the use of preserved cells in hemagglutination technique as compared with freshly washed erythrocytes are discussed. It is suggested that results be read by means of a sedimentation method. The anti-globulin test has been found to be useful in improving the sensitivity of the preserved cell hemagglutination reaction providing precautions are taken to prevent the adsorption of non-specific proteins on the tanned erythrocytes. Microfilm \$2.00; Xerox \$4.80. 91 pages.

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